BIOLOGICAL ASSESSMENT OF THE WASHINGTON WATER QUALITY STANDARDS

for the
U.S. FISH AND WILDLIFE SERVICE

and the
NATIONAL MARINE FISHERIES SERVICE

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I. BACKGROUND INFORMATION

A. EPA'S ACTION

The purpose of this biological assessment is to review adopted changes to the State of Washington's Water Quality Standards (WQS) in sufficient detail to determine to what extent this action may affect any of the threatened, endangered, proposed, or candidate species discussed below. The EPA approval of Washington WQS is considered a federal action and the EPA must comply with the Section 7 consultation requirements of the ESA. Section 7 states that "all federal agencies shall utilize their authorities on furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species" and "each federal agency shall insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species." This biological assessment is prepared in accordance with legal requirements set forth under Section 7 of the Endangered Species Act (ESA) 16 U.S.C. 1536(c).

Pursuant to Section 303(c) of the Clean Water Act (CWA), states are required to adopt water quality standards to restore and maintain the chemical, physical, and biological integrity of the nation's waters. These standards must be submitted to EPA for review and subsequent approval or disapproval. States are further required to review and, if appropriate, revise their standards every three years. This process is known as the triennial review.

The Washington State Department of Ecology (Ecology) began its last triennial review in 1994. Phase I of the review was completed on November 18, 1997 when Washington State adopted changes to its WQS at Chapter 173-201A WAC. The revised standards were submitted to the EPA for approval on December 5, 1997 and approved by the EPA on February 6, 1998 with the caveat that an outcome of ESA consultation might be reconsideration of the approval action. EPA's review is limited to the revisions made to the Washington WQS during the 1994-97 triennial review and this biological assessment examines only the effects of adopted changes in marine copper and cyanide criteria, a portion of Washington's triennial review revisions; as such, this document concentrates primarily on revisions that affect aquatic life. Other changes to Washington's WQS in 1997 will be addressed later.

Prior to this triennial review, on December 22, 1992, EPA promulgated the National Toxics Rule (NTR) which imposed numeric toxic criteria (both aquatic life and human health) on states which did not have numeric criteria for these pollutants. The EPA promulgated chronic marine cyanide and chronic marine copper criteria for Washington. Under the NTR, states were provided the option of later adopting toxics criteria on their own and, once approved by EPA, the state could be removed from the NTR. As part of its 1994-1997 triennial review, Washington is seeking to replace two federally promulgated aquatic life criteria with the State's own criteria: the chronic marine cyanide standard in Puget Sound/Strait of Georgia and the statewide chronic marine copper standard.

B. OVERVIEW OF THE WATER QUALITY STANDARDS PROGRAM

A water quality standard defines the water quality goals of a waterbody by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by preventing degradation of water quality through antidegradation provisions. The CWA provides the statutory basis for the water quality standards program and defines water quality goals. For example, Section 101(a) states in part that, wherever attainable, waters achieve a level of quality that provides for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water ("fishable/swimmable").

In addition to adopting water quality standards, states are required to review and revise standards every three years. This public process, commonly referred to as the triennial review, allows for new technical and scientific data to be incorporated into the standards.

The regulatory requirements governing the program, the Water Quality Standards Regulation (published at 40 CFR 131), set forth specifications for the water quality standards program as well as the minimum requirements for a state water quality standards submission. The minimum requirements that must be included in the state standards are: designated uses, criteria to protect the uses, and an antidegradation policy to protect existing uses and high quality waters. In addition to these elements, the regulations allow for states to adopt discretionary policies such as mixing zones and water quality standards variances. These policies are also subject to EPA review and approval.

States have primary responsibility for developing appropriate designated uses. These uses either reflect a water quality goal for the waterbody or a use which is actually attained. The state then sets criteria which will provide for a level of water quality such that the designated uses can be attained and protected.

Section 303(c)(2)(B) of the CWA requires states to adopt numeric criteria for all toxic pollutants listed pursuant to the CWA section 307(a)(1) for which criteria have been published under section 304(a). EPA's water quality criteria for toxic pollutants are based on the latest available scientific data. EPA publishes criteria documents as guidance to states. States consider these criteria documents, along with the most recent scientific information, when adopting regulatory criteria.

Once the standards are officially adopted by the state, they are submitted to EPA for review and approval or disapproval. EPA reviews the standards to determine whether the analyses performed are adequate and evaluates whether the designated uses and criteria are protective and compatible throughout the waterbody. EPA makes a determination as to whether the standards meet the requirements of the CWA and EPA's water quality standards regulations.

EPA then formally notifies the state of these results. If EPA determines that any such revised or new water quality standard is not consistent with the applicable requirements of the CWA, EPA is required to specify the disapproved portions and the changes needed to meet the requirements. The state is then given an opportunity to make appropriate changes. If the state does not adopt the required changes, regulations require that EPA promulgate federal regulations to replace those disapproved portions.

C. OVERVIEW OF WASHINGTON'S WATER QUALITY PROGRAMS

Water quality standards are important for several environmental, programmatic, and legal reasons. Control of pollutants in surface waters is necessary to achieve the CWA's goals and objectives, including the protection of all species dependent upon the aquatic environment. Water quality standards provide the framework necessary to identify, protect, and restore the water quality in Washington's surface waters.

Water quality standards are essential to both state and EPA efforts to address water quality problems. The water quality goals established by the water quality standards enhance the effectiveness of many of the state, local, and federal water quality programs including point source permit programs, non-point source control programs, development of total maximum daily load limitations (TMDLs), and ecological protection efforts. Washington State's responsibilities under the CWA include adopting water quality standards, assessing water quality, developing TMDL plans for waters not meeting the state's standards, implementing the National Pollutant Discharge Elimination System (NPDES) permit program, and controlling non-point sources of pollution (Washington State Department of Ecology 2000).

Data acquired during chemical, physical, and biological monitoring studies are utilized in evaluating the quality of the state's waters and designing appropriate water quality controls. Waters identified as "water quality limited" are included on the 303(d) list and reported in the 305(b) report. While both are currently biennial submissions, the 2000 303(d) list requirement was waived while EPA revised their implementing regulations. The 303(d) list identifies water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, while the 305(b) report details the current condition of all the state's waters.

Six hundred and forty three impaired waterbody segments are included on Washington's 1998 303(d) list. These segments represent 2% of all the waters in Washington, or 58% of the 1,099 segments for which Washington has data. According to Ecology, the waterbodies measured were generally those that had a history of pollution.

A number of the waterbody segments exceed standards for more than one pollutant. Pollutants identified on the 303(d) list fall into several major groups, including sediment, nutrients, metals, bacteria, oxygen demand, and toxic organics. According to Ecology, bacteria violations account for 285 listings, while temperature affects a total of 282 waters. Dissolved oxygen impairs 133 waterbodies, and pH affects 87 waterbodies. Seventy-eight waterbodies suffer from elevated toxics and 28 have excess nutrients. A total of 38 waterbodies are listed for low flow problems (Washington State Department of Ecology 2001).

In many of Washington's river basins, human activities such as timber harvesting, road building, stream channelization, farming, mining, and urbanization have resulted in the simplification of habitat and a reduction in aquatic system quality. These activities have caused or contributed to the loss of large woody debris, sedimentation, loss of riparian vegetation, loss of frequency and depth of pools, increase in temperature, and other effects which have reduced habitat quality. Habitat simplification and diminished quality leads to a decrease in the health and diversity of aquatic communities. According to Ecology, the primary water quality problem for lakes in Washington is excessive nutrients which cause increased algae and aquatic plant growth and lower the level of dissolved oxygen (Washington State Department of Ecology, 2000). In estuaries and streams evaluated by Ecology, the principal anthropogenic water quality problem is fecal coliform bacteria from agricultural activity, inadequate wastewater treatment plants, and failing on-site sewage systems (Washington State Department of Ecology 2000).

For each "water quality limited" water on the 303(d) list, Ecology develops Total Maximum Daily Load (TMDL) limitations for the water body. As part of this process, Ecology determines the total amount of a pollutant (load) that the receiving waters can assimilate while maintaining water quality standards and allocates these loads to the various sources. The CWA has the following requirements for TMDL assessments: 1) all contributing sources, both point and non-point, be identified and addressed, 2) that seasonal variations be taken into account, 3) that a margin of safety be established to account for uncertainties, and 4) that the attainment of the TMDL lead to the attainment of applicable water quality standards. Ecology is also responsible for implementing the TMDL. Per a 1998 legal settlement, Washington must develop and implement TMDLs for all waters on the 1998 303(d) list by the end of 2013.

Washington State's primary regulatory program for reducing pollutant discharges to Washington's water systems is point source pollution prevention and management (Washington State Department of Ecology 2000). This program concentrates on regulating discharge of surface and groundwater pollutants from both industrial and municipal sources (Washington State Department of Ecology 2000). A principal application of EPA's approved and/or promulgated water quality standards is the National Pollutant Discharge Elimination System (NPDES) permit program, created by Section 402 of the Federal Water Pollution Control Act. Washington State has established a state permit program, codified at WAC 172-222-010, applicable to the discharge of pollutants and other wastes and materials to the Washington's surface waters (Washington State Department of Ecology December 2000). Washington's WQS provide guidelines for NPDES permit writers to develop conditions and limits for inclusion in such permits to point source dischargers. NPDES permits in the State of Washington are issued and enforced by the State.

Non-point source pollution contributes more to the pollution of Washington waters than point source pollution, and includes agricultural and road runoff. According to Ecology, non-point source pollution poses one of the most significant health and economic threats to Washington's population, threatening aquatic species and drinking water and contributing to flooding and the loss of arable land (Washington State Department of Ecology 2000). Ecology is responsible for the overall coordination and implementation of Washington's non-point source pollution prevention and management program. Implementation of the program is accomplished through interagency coordination with local, state, and federal natural resource agencies. Using the watershed approach, Ecology addresses non-point source pollution in a number of ways, including forest practices and agricultural technical assistance, dairy waste permitting, enforcement activities, local government assistance, water quality assessment, monitoring, and standards, and the Federal Non-point Source Program (Washington State Department of Ecology 2000). The EPA contributes to Ecology's effort by providing funding and assistance for implementing non-point source controls. Assistance in water quality management plan development, funding, and implementation is also available through the programs of numerous state and federal natural resource agencies.

D. OVERVIEW OF WASHINGTON'S WATER QUALITY STANDARDS REVISIONS

Washington's Surface Water Quality Standards are codified in Title 173, Chapter 201A, of the Washington Administrative Code (173-201A WAC). The following is a brief overview of the changes in toxic substances criteria covered by this assessment. Washington has adopted criteria for marine cyanide and copper, and the numeric criteria can be found at WAC 173-201A-040. (See Appendix A for full text.)

Cyanide

Under the National Toxics Rule, the EPA promulgated a chronic marine cyanide criterion for Washington of 1.0 ☞g/l, a 4-day average concentration not to be exceeded more than once every three years on average. The State of Washington has adopted changes in this criterion, with the revisions limited to Puget Sound waters and the waters of the eastern Straits of Georgia. The new criteria are 9.1 ☞g/l acute (as a 1-hour average concentration) and 2.8 ☞g/l chronic (as a 4-day average concentration) and are applicable only to waters which are east of a line from Point Roberts to Lawrence Point, to Green Point to Deception Pass, and south from Deception Pass and of a line from Partridge Point to Point Wilson. The previous acute marine criterion of 1.0 ☞g/l and the NTR promulgated chronic marine criterion of 1.0 ☞g/l remain in effect for all other marine waters in Washington. (See Appendix B for a regional map.)

The decision to change the marine cyanide criterion was based on a study sponsored by the Western States Petroleum Association (WSPA). The EPA's national marine water quality criteria for cyanide were created using data from eight taxa (see Table 1). From the data set, it is evident that the rock crab data are driving the criterion. However, *Cancer irroratus* is not resident to Puget Sound. The WSPA, concerned about the applicability of the rock crab study, proposed to EPA that evaluation of resident Washington species of *Cancer* and the substitution of this data for the *Cancer* data in the EPA national marine cyanide criterion data set would provide a more appropriate, site-specific criterion. The WSPA proposed approach was accepted by the EPA and the changes in the marine cyanide criteria reflect this research.

Table 1. EPA's National Marine Water Quality Criterion for Cyanide

Rank	Species	Genus Mean Acute Value (☞g/L)
8	Common Atlantic Slippershell, *Crepidula fornicata*	>10,000
7	Amphipod, *Ampelisca abdita*	995.9
6	Winter flounder, *Pseudopleuronectes americanus*	372
5	Sheepshead minnow, *Cyprinodon variegatus*	300
4	Mysis, *Mysidopsis bahia/bigelowi*	118.4
3	Atlantic silverside, *Menidia menidia*	59
2	Copepod, *Acartia tonsa*	30
1	Rock crab, *Cancer irroratus*	4.893

Copper

The previous marine criteria in Washington were 2.5 ☞g/l acute and 2.4 ☞g/l chronic. Washington has adopted revised standards of 4.8 ☞g/l acute (a 1-hour average concentration not to be exceeded more than once every three years on average) and 3.1 ☞g/l chronic (a four-day average concentration not to be exceeded more than once every three years on average). These changes reflect the proposed revisions to the national recommended water quality criteria in 1995, which were finalized in December 1999.

E. DESCRIPTION OF ACTION AREA

The Washington Water Quality Standards apply to all surface waters of Washington, defined as lakes, river, ponds, streams, inland waters, saltwaters, wetlands, and all other surface waters and water courses within the jurisdiction of the State of Washington (see WAC 173-201A-020). EPA's approval action does not apply to, and thus the action area of this consultation does not include, any waters within Indian Country (as defined in 18 USC 1151).

The action area of this consultation differs for each of the standards revisions under consideration. The marine cyanide criteria applies to Puget Sound, or waters which are east of a line from Point Roberts to Lawrence Point, to Green Point to Deception Pass, and south from Deception Pass and of a line from Partridge Point to Point Wilson. The action area of the marine copper criteria is broader and includes all marine waters in Washington, i.e. both the marine waters of Puget Sound/Strait of Georgia and the Pacific Ocean within the territorial limits of the State of Washington.

II. DESCRIPTION OF THE SPECIES

A. SPECIES OF CONCERN

Pursuant to advice provided by the U.S. Fish and Wildlife Service (USFWS 2001) and the National Marine Fisheries Service (NMFS 2001) the following species will be considered in this assessment. This list contains all species known or suspected to occur in the State of Washington that are currently listed as threatened or endangered, proposed for listing, or candidates for listing under the Endangered Species Act. As this assessment covers two different action areas, species of concern differ for the revisions to the marine cyanide and marine copper standards (please see Appendix C).

Species of Concern for ESA consultation

1. Salmonids

a. Chinook Salmon *(Oncorhynchus tshawytscha)*
    i. Snake River Fall
    ii. Snake River Spring/Summer
    iii. Upper Columbia River Spring
    iv. Lower Columbia River
    v. Puget Sound
    vi. Upper Willamette River

b. Chum Salmon *(Oncorhynchus keta)*
    i. Columbia River
    ii. Hood Canal Summer

c. Sockeye Salmon *(Oncorhynchus nerka)*
    i. Snake River
    ii. Ozette Lake

d. Steelhead *(Oncorhynchus mykiss)*
    i. Upper Columbia River Basin
    ii. Snake River Basin
    iii. Upper Willamette River
    iv. Lower Columbia River
    v. Middle Columbia River

e. Coho Salmon *(Oncorhynchus kisutch)*
    i. Puget Sound/Strait of Georgia
    ii. Lower Columbia River/Southwest Washington

f. Sea-run Cutthroat Trout *(Oncorhynchus clarki clarki)*
    i. Southwest Washington/Columbia River

g. Bull Trout *(Salvelinus confluentus)*
    i. Coastal/Puget Sound
    ii. Columbia River

h. Dolly Varden *(Salvelinus malma)*

2. Birds

a. Bald Eagle *(Haliaeetus leucocephalus)*
b. Marbled Murrelet *(Brachyramphus marmoratus)*
c. Short-tailed Albatross *(Phoebastria albatrus)*

d. Brown Pelican *(Pelecanus occidentalis)*
e. Western Snowy Plover *(Charadrius alexandrinus nivosus)*

3. Marine Mammals

a. Humpback Whale *(Megaptera novaeangliae)*
b. Blue Whale *(Balaenoptera musculus)*
c. Fin Whale *(Balaenoptera physalus)*
d. Sei Whale *(Balaenoptera borealis)*
e. Sperm Whale *(Physeter macrocephalus)*
f. Steller Sea Lion *(Eumetopias jubatus)*

4. Marine Turtles

a. Green Sea Turtle *(Chelonia mydas)*
b. Leatherback Sea Turtle *(Dermochelys coriacea)*
c. Loggerhead Sea Turtle *(Caretta caretta)*
d. Olive Ridley Sea Turtle *(Lepidochelys olivacea)*

<u>Discussion Species</u>

The listed, proposed, and candidate species that will not be the focus of this consultation are listed below. It was determined that these species would not be directly or indirectly impacted by changes to the marine copper and cyanide criteria and thus approval of the changes to these criteria is not likely to have an adverse effect on these species. The following is a list of species.

<u>Amphibians</u>
Oregon spotted frog *(Rana pretiosa)*

<u>Birds</u>
Northern Spotted Owl *(Strix occidentalis caurina)*

<u>Insects</u>
Mardon Skipper *(Polites mardon)*
Oregon Silverspot Butterfly *(Speyeria zerine hippolyta)*

<u>Mammals</u>
Canada Lynx *(Lynx canadensis)*
Columbian White-tailed Deer *(Odocoileus virginianus leucurus)*
Gray Wolf *(Canis lupus)*
Grizzly Bear *(Ursus arctos = U.a. horribilis)*

<u>Plants</u>
Bradshaw's Desert Parsley *(Lomatium bradshawii)*
Golden Paintbrush *(Castilleja levisecta)*

Kincaid's Lupine *(Lupinus sulphureus)*
Marsh Sandwort *(Arenaria Paludicola)*
Nelson's Checker-mallow *(Sidalcea nelsoniana)*
Northern Wormwood *(Artemisia campestris* var. *warmskioldii)*
Showy Stick-seed *(Hackelia venusta)*
Ute Ladies-tresses *(Spiranthes diluvialis)*
Water Howellia *(Howellia aquatilis)*
Wenatchee Mountains Checker-mallow *(Sidalcea oregana* var. *calva)*

EPA approval of the revisions to the State of Washington's WQS will have no effect on the species listed above. These species would (1) not be found in the marine environment, (2) not rely upon the marine environment for any part of their life cycle, nor (3) forage within the marine environments affected by these standard modifications.

Oregon spotted frog is not likely to be directly affected by EPA's approval of the changes to Washington's WQS. The historic range of the Oregon spotted frog, a candidate for listing, was from southwest British Columbia through western Washington and Oregon into northern California. Today its range has diminished greatly, and in Washington the species is known from four localities in Washington (in Klickitat, Skamania, and Thurston counties) occurring at elevations ranging from 40 m (130 feet; Black River Watershed, Thurston County) to 620 meters (2040 feet; southwest of Mount Adams, Skamania County) (US FWS 2001, WSDOT 2000). Oregon spotted frog populations in Washington do not encounter marine waters, and, as the Oregon spotted frog is found only in freshwater environments (WDFW 1997), **EPA's approval of the changes to Washington's WQS will not affect the Oregon spotted frog**.

Northern spotted owl is not likely to be directly affected by EPA's approval of the changes to Washington's WQS. In Washington, the northern spotted owl is found in old growth forests (US FWS 2001a), where all four of their habitat components (nesting, roosting, foraging, and dispersal) can be found. The WDFW (Washington Department of Fish and Wildlife) estimates that there were 851 site centers of northern spotted owl pairs or resident single owls in Washington State between 1989 and 1993 (Pacific Biodiversity Institute 2001b). These populations are found in four physiographic provinces in Washington: the Eastern and Western Cascades, Western Lowlands, and Olympic Peninsula Provinces (Pacific Biodiversity Institute 2001b). Spotted owl prey does not include marine aquatic life. Their primary prey are flying squirrels, woodrats, mice and voles, though they consume a wide variety of species, including birds, insects, and reptiles (WSDOT 2001). **EPA's approval of the changes to Washington's WQS will not affect the northern spotted owl.**

Oregon silverspot butterfly and Mardon skipper are not likely to be directly affected by EPA's approval of the changes to Washington's WQS.

- Though the **Oregon silverspot butterfly** is found in coastal areas (salt spray meadows, stabilized dunes, and/or montane meadows which are surrounded by forests), its habitat and food supply is terrestrial (WDFW 1999, WSDOT

2001a).

- The **mardon skipper** is not found in or near marine environments, and inhabits two areas in Washington: the Puget Prairie and the South Cascades (WDFW 1999b). In both areas the mardon skipper is found in open grasslands, wetlands, or riparian areas (WDFW 1999a).

EPA's approval of the changes to Washington's WQS will not affect the mardon skipper and the Oregon silverspot butterfly.

Canada lynx, Columbian white-tailed deer, grizzly bear, and gray wolf are not likely to be directly affected by EPA's approval of the changes to Washington's WQS. These terrestrial species are not currently found in Puget Sound or coastal areas, and do not rely upon or forage in marine environments.

- The **Canada lynx** is found in sub-alpine, boreal forests and its historical habitat in Washington is in the northeast and north-central regions and along the east slope of the Cascades (65FR16051). The lynx's primary prey is the snowshoe hare, though it does prey opportunistically on small mammals and birds (65FR16053, US FWS 2001b).
- The **Columbian white-tailed deer** was formerly distributed throughout the bottomlands and prairie woodlands of the lower Columbia, Willamette, and Umpqua River basins in Oregon and southern Washington (64FR59729). Currently, only a small herd of 200 to 400 animals survives in the lower Columbia River area of Oregon and Washington (64FR59729).
- The **grizzly bear**, once found over much of North America west of the Great Plains, is now found only in portions of the Northern Rockies and North Cascades (Pacific Biodiversity Institute 2001a). In Washington, the grizzly is found in both the North Cascades ecosystem and the Selkirk Mountains (Pacific Biodiversity Institute 2001a, National Park Service 2001a), with no verified sightings in Washington's coastal areas or Puget Sound. One pathway by which the grizzly might be affected by copper or cyanide in marine waters is through the consumption of salmon migrating back to their natal streams, or a decrease in the number of salmon returning. However, as will be discussed later in this document, food chain effects are unlikely for these contaminants. In addition, the greatest threats to the grizzly are habitat degradation, caused by development and road building, and human induced mortality, as grizzlies become habituated to humans, leading to conflicts.
- The **gray wolf** was historically found throughout Washington. According to the Washington Department of Fish and Wildlife (WDFW), a very small resident gray wolf population is currently found in the North Cascades ecosystem (Pacific Biodiversity Institute 2001). There have been wolf sightings as far south as the Oregon border, throughout the Cascade Range, and in the Selkirk Mountains in the state's northeast corner (Pacific Biodiversity Institute 2001, National Park Service 2001). The exact population size in Washington is unknown due to the lack of data and difficulty of tracking individual wolves, who may have home ranges of up to 100 square miles (Pacific Biodiversity Institute

2001). Though still highly controversial, the success of re-introduction efforts in Yellowstone and Idaho has inspired a proposal for reintroduction of wolves on the Olympic peninsula (Pacific Biodiversity Institute 2001). For wolf species that may eventually reside in Puget Sound or coastal areas, the effects of these WQS revisions are not likely to be adverse as wolves are a terrestrial species that feed primarily on large, hoofed animals, including deer and elk (though they also consume beaver and other small mammals as secondary prey).

Canada lynx, Columbian white-tailed deer, grizzly bear, and gray wolf will not be affected by EPA approval of the changes in Washington's WQS.

Bradshaw's desert parsley, golden paintbrush, Kincaid's lupine, marsh sandwort, Nelson's checker-mallow, northern wormwood, showy stick-seed, Ute ladies-tresses, water howellia and the Wenatchee Mountains checker-mallow will not be directly affected by EPA's approval of the changes to Washington's WQS.

- Historically, **Bradshaw's lomatium** was endemic to the southern portion of western Washington in the Puget Trough physiographic province and to the central and southern portions of the Willamette Valley physiographic province in western Oregon (Washington Natural Heritage Program 2000b). It is now limited to a few sites in Oregon and Washington (WSDOT 1995). A majority of remaining plants are found in Oregon; as of 2000, Washington had two occurrences in Clark County (Washington Natural Heritage Program 2000b). Bradshaw's lomatium is found in wet, seasonally flooded, low elevation prairie and grassland habitat (Washington Natural Heritage Program 2000b).
- There are eight populations of **golden paintbrush** in Washington's Puget lowlands (62FR31741); this plant is found in grassy, low elevation meadows in the Puget Trough of western Washington (WSDOT 2001b).
- **Kincaid's lupine** is found in two small sites in Lewis County in southern Washington (65FR3875). It was traditionally found in native grassland habitat in the Willamette Valley. In Lewis County, Kincaid's lupine is found in dry, open woods, banks, meadows and roadsides (WSDOT 2001c).
- **Marsh sandwort** is historically know from freshwater swamps and marshes along the Washington coast (58FR41378). The US FWS contracted the Department of Natural Resources' Washington Natural Heritage Program to conduct a status survey for *Arenaria paludicola* in Washington; the Natural Heritage Program has since concluded that this species is possibly extinct or extirpated in Washington (58FR41378, Washington Natural Heritage Program 2000).
- **Nelson's checkermallow** is found at one site in Cowlitz County, in southwestern Washington (58FR41378-41383). The Cowlitz County site is located in the Coast Range, across the Columbia River from Oregon. The checkermallow is found in a number of different habitat types: along streams and in meadow or other relatively open areas, such as roadsides. It is generally found in areas where prairie or grassland remnants persist, such as along fencerows, drainage swales, and at the edges of plowed fields adjacent to wooded

areas. Standing water is
present at some sites.

- **Northern wormwood**, a candidate for listing, is found in the Columbia Basin physiographic province and is currently known from two widely disjunct sites along the Columbia River in WA, one each in Klickitat and Grant counties (Washington Natural Heritage Program 2000a). The northern wormwood's habitat is dry arid areas on a substrate of basalt, compacted cobble, or sand in relatively flat terrain that supports shrub-steppe vegetation (WSDOT 2001d).
- **Showy stickseed**, proposed for listing as endangered under the ESA, is a local endemic currently found only in the Wenatchee Mountains of Chelan County (WSDOT 2001e). This species is now limited to a group of less than 150 plants at the Tumwater Canyon site in Chelan county (65FR7339). Dry, loose granitic sand, rock outcrops, and talus are its most common habitats (WSDOT 2001e).
- **Ute ladies-tresses** is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams (57FR2048-2054). The species occurs primarily in areas where the vegetation is relatively open and not overly dense, overgrown, or overgrazed (57FR2048-2054). Populations occur in relatively low elevation riparian meadows in the interior Western United States (57FR2048-2054).
- **Water howellia** is found in western Washington, western Oregon, northern Idaho, and western Montana (WSDOT 2001f). It grows in firm consolidated clay and organic sediments that occur in wetlands associated with ephemeral glacial pothole ponds and former river oxbows (59FR35860-35864). Water howellia's microhabitats include shallow water and the edges of deep ponds that are partially surrounded by deciduous trees (59FR35860-35864).
- The **Wenatchee Mountains checkermallow** is found in central Washington. Essential habitat features include open meadows with surface water or saturated upper soil profiles in the spring and early summer, open conifer forests dominated by ponderosa pine and Douglas-fir, and the margins of shrub and hardwood thickets.(WSDOT 2001g, 64FR71681). Critical habitat has been proposed for the Wenatchee Mountains checkermallow, and occurs entirely within the bounds of Chelan county, Washington (66FR4783).

Bradshaw's desert parsley, golden paintbrush, Kincaid's lupine, marsh sandwort, Nelson's checker-mallow, northern wormwood, showy stick-seed, Ute ladies-tresses, water howellia and the Wenatchee Mountains checker-mallow are terrestrial or freshwater plant species and will not be affected by EPA's approval of the changes in Washington's WQS.

For the remaining Federally listed aquatic and aquatically-dependent species, we shall address each of the adopted major water quality standard revisions separately.

1. SALMONIDS

a. Chinook Salmon *(Oncorhynchus tshawytscha)*
The following life history information is taken from 63FR11481, March 9, 1998.

Chinook salmon are easily distinguished from other *Oncorhynchus* species by their large size. Adults weighing over 120 pounds have been caught in North American waters. Chinook salmon are very similar to coho salmon in appearance while at sea (blue-green back with silver flanks), except for their large size, small black spots on both lobes of the tail, and black pigment along the base of the teeth. Chinook salmon are anadromous and semelparous. This means that as adults they migrate from a marine environment into the freshwater streams and rivers of their birth (anadromous) where they spawn and die (semelparous). Adult female chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. Redds will vary widely in size and in location within the stream or river. The adult female chinook may deposit eggs in four to five “nesting pockets” within a single redd. After laying eggs in a redd, adult chinook will guard the redd from four to 25 days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Stream flow, gravel quality, and silt load all significantly influence the survival of developing chinook salmon eggs. Juvenile chinook may spend from three months to two years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature.

Among chinook salmon two distinct races have evolved. One race, described as a “stream-type” chinook, is found most commonly in headwater streams. Steam-type chinook salmon have a longer freshwater residency, and perform extensive offshore migrations before returning to their natal streams in the spring or summer months. The second race is called the “ocean-type” chinook, which is commonly found in coastal steams in North America. Ocean-type chinook typically migrate to sea within the first three months of emergence, but they may spend up to a year in freshwater prior to emigration. They also spend their ocean life in coastal waters. Ocean-type chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. The difference between these life history types is also physical, with both genetic and morphological foundations.

Juvenile steam- and ocean-type chinook salmon have adapted to different ecological niches. Ocean-type chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. The brackish water areas in estuaries also moderate physiological stress during parr-smolt transition. The development of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and glacially scoured, unproductive, watersheds, or a means of avoiding the impact of seasonal floods in the lower portion of may watersheds.

Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, that are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of subyearling smolts. At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 73-134 mm depending on the river system, than their ocean-type (subyearling) counterparts and are, therefore, able to move offshore relatively quickly.

Coast wide, chinook salmon remain at sea for one to six years (more common, two to four years), with the exception of a small proportion of yearling males, called jack salmon, which mature in freshwater or return after two or three months in salt water. Ocean- and steam-type chinook salmon are recovered differentially in coastal and mid-ocean fisheries, indicating divergent migratory routes. Ocean-type chinook salmon tend to migrate along the coast, while stream-type chinook salmon are found far from the coast in the central North Pacific. Differences in the ocean distribution of specific stocks may be indicative of resource partitioning and may be important to the success of the species as a whole.

There is a significant genetic influence to the freshwater component of the returning adult migratory process. A number of studies show that chinook salmon return to their natal streams with a high degree of fidelity. Salmon may have evolved this trait as a method of ensuring an adequate incubation and rearing habitat. It also provides a mechanism for reproductive isolation and local adaptation. Conversely, returning to a stream other than that of one's origin is important in colonizing new areas and responding to unfavorable or perturbed conditions at the natal steam.

Chinook salmon stocks exhibit considerable variability in size and age of maturation, and at least some portion of this variation is genetically determined. The relationship between size and length of migration may also reflect the earlier timing of river entry and the cessation of feeding for chinook salmon stocks that migrate to the upper reaches of river systems. Body size, which is correlated with age, may be an important factor in migration and redd construction success. Under high density conditions on the spawning ground, natural selection may produce stocks with exceptionally large-sized returning adults.

Early researchers recorded the existence of different temporal "runs" or modes in the migration of chinook salmon from the ocean to freshwater. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes. Seasonal "runs" (i.e., spring, summer, fall, or winter) have been identified on the basis of when adult chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual time of spawning. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

Pathogen resistance is another locally adapted trait. Chinook salmon from the Columbia River drainage were less susceptible to *Ceratomyxa shasta*, an endemic pathogen, then stocks from coastal rivers where the disease is not know to occur. Alaskan and Columbia River stocks of chinook salmon exhibit different levels of susceptibility to the infectious hematopoietic necrosis virus (IHNV). Variability in temperature tolerance between populations is likely due to selection for local conditions; however, there is little information on the genetic basis of this trait.

Factors influencing the decline of chinook salmon include: the present or threatened destruction, modification, or curtailment of the species habitat or range such as loss, damage or change to the species' natural environment through water diversions, forestry, agriculture, mining, and urbanization; over- utilization of the species for commercial, recreational, scientific or educational purposes, particularly over-fishing; predation, introduction of non-native species, and habitat loss or impairment increasing stress on any surviving individuals and thus increasing susceptibility of the species to numerous bacterial, protozoan, viral, and parasitic diseases; and, the inadequacy of existing regulatory mechanism to prevent the decline of the species. Refer to 63FR11498 for a detailed generic discussion of factors affecting chinook salmon ESU's.

i. Snake River Fall Chinook - Threatened

The Snake River fall-run ESU (Evolutionarily Significant Unit[1]) was listed as threatened in Oregon, Washington and Idaho on April 22, 1992 (57FR14653). Critical habitat for Snake River fall chinook salmon was listed on December 28, 1993 and consists of river reaches of the Columbia, Snake, and Salmon Rivers and all tributaries of the Snake and Salmon Rivers presently or historically accessible to Snake River fall chinook salmon, except reaches above impassable natural falls and Dworshak's and Hells Canyon dams (58FR68543). It does not include marine areas. This critical habitat designation was expanded on March 9, 1998 to include the Deschutes River (63FR11515).

Snake River fall chinook have a life history pattern typical of 'ocean-type' chinook. Generally, ocean-type chinook spend all of their oceanic life in coastal waters less than 1000 km from their natal streams and return to spawn in those natal streams in the fall at age 2-5. Adult Snake River fall chinook salmon enter the Columbia River in July and migrate into the Snake River from August through October. Fall chinook salmon natural spawning is primarily limited to the Snake River below Hells Canyon Dam, and the lower reaches of the Clearwater, Grand Ronde, Imnaha, Salmon and Tucannon Rivers. Fall chinook salmon generally spawn from October through November and fry emerge from March through April. Emergent fry migrate seaward slowly from the mainstem Snake River within several weeks of emergence. Most fall chinook have migrated to sea within their first year. In the ocean, juvenile fall chinook feed primarily on herring, pelagic amphipods and crab megalopa, while adult fish feed on herring and squid (Groot and Margolis 1991).

Almost all historical Snake River fall-run chinook salmon spawning habitat in the Snake River Basin was blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries (NMFS 1998). Mainstem Columbia and Snake River hydroelectric development has resulted in a major disruption of migration corridors and affected flow regimes and estuarine habitat (NMFS 1998). The ESU's range has also been affected by

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[1]An Evolutionarily Significant Unit or "ESU" is a distinctive group of Pacific salmon, steelhead, or sea-run cutthroat trout.

agricultural water withdrawals, grazing, and vegetation management (NMFS 1998). The continued straying by non-native hatchery fish into natural production areas is an additional source of risk.

Previous assessments of stocks within the Snake River fall-run ESU have identified several as being at risk or of concern (NMFS 1998). Three stocks have been identified as extinct (Umatilla River, Walla Walla River, and Snake River above Hells Canyon Dam) and one as having a high risk of extinction (Snake River) (NMFS 1998). Assessing extinction risk is difficult because of the geographic discontinuity and the disparity in the status of the two remaining populations (NMFS 1998). Historically, the Snake River populations dominated production in this ESU. No reliable historic estimates of abundance are available for Snake River fall chinook salmon. According to Irving and Bjornn, the mean number of fall chinook returning to the Snake River declined from 72,000 annually between 1938 and 1949 to 29,000 from 1950 through 1959 (Bjornn and Horner 1981). Production from the Deschutes River was presumably only a small fraction of historic production in the ESU, though in recent years spawning fish returns in the Deschutes have exceeded those of the Snake River (NMFS 1998). Long term abundance trends for the Deschutes River are slightly upward, while for the Snake River they are downward; for both populations, short-term trends are upward (NMFS 1998).

NMFS has concluded that, in spite of the relative health of the Deschutes River population, the ESU as a whole is likely to be in danger of extinction in the foreseeable future (NMFS 1998). For a general discussion of factors influencing the decline of chinook salmon ESU's, see Section 1a: Chinook Salmon, or refer to 63FR11498.

ii. Snake River Spring/Summer Chinook - Threatened

The Snake River spring/summer-run ESU was listed as threatened in Oregon, Washington, and Idaho on April 22, 1992 (57FR14653). Critical habitat for this ESU was designated on December 28, 1993 (58FR68543) and consists of river reaches of the Columbia, Snake, and Salmon Rivers, and all tributaries of the Snake and Salmon Rivers (except the Clearwater River) presently or historically accessible to Snake River spring/summer chinook salmon (except reaches above impassable natural falls and Hells Canyon Dam). It does not include marine areas.

Snake River spring/summer chinook salmon differ from fall chinook in both their freshwater and seawater life histories. These 'stream-type' chinook spend one or more years after emergence in freshwater before migrating to offshore oceanic waters. They migrate extensively in the ocean, traveling into North Pacific waters, including Bristol Bay and the Bering Sea (Groot and Margolis 1991). The spring/summer chinook then return to freshwater after 2-3 years. Entering the system in the spring, these chinook migrate long distances to spawn in small, high elevation streams off the Snake and Salmon Rivers (NMFS 1996). Similar to fall chinook, juvenile spring/summer chinook feed primarily on herring, pelagic amphipods and crab megalopa, while adult fish feed on herring and squid during their ocean phase (Groot and Margolis 1991).

This century has seen a severe, human-induced decline of the once robust runs of Snake River spring and summer chinook salmon, with 95% of the total reduction in abundance occurring prior to the mid 1900's (NMFS 1991). Over the past three to four decades, the remaining population was further reduced nearly tenfold to about 0.5% of the estimated historical abundance (NMFS 1991). NMFS states that short-term projections for spring and summer chinook salmon in the Snake River are not optimistic and data indicates that spring and summer chinook salmon in the Snake River are in jeopardy with present abundance a small fraction of historical abundance and threats to subpopulations greater still (NMFS 1991). NMFS does not feel that the ESU is in imminent danger of extinction throughout a significant portion of its range; however, they feel it is likely to become endangered in the near future if corrective measures are not taken (NMFS 1991).

Threats to Snake River spring/summer chinook salmon include hydropower development, ocean and river harvest, and hatchery programs. Hydropower development affects spring/summer chinook in the same manner as fall chinook are affected. Hatchery programs may affect spring/summer chinook in the following ways: taking of fish for broodstock purposes, behavioral and genetic interactions between wild and hatchery reared fish, and competition, predation, and the spread of disease by hatchery fish (NMFS 1996). Harvest on these populations is low, with very low ocean harvest and moderate instream harvest (PFMC 1996). At present, only tribal fisheries are permitted in the Snake River. The average harvest rate from 1986-90 was estimated to be 10.7%, and the 1995 and 1996 harvests were estimated to be 6.1 and 5.5%, respectively (PFMC 1997). For a discussion of general factors influencing the decline of chinook salmon ESU's, see Section 1a: Chinook Salmon, or refer to 63FR11498.

iii. Upper Columbia River Spring Chinook - Endangered

The Upper Columbia River spring-run chinook was listed as an endangered species on March 24, 1999 (64FR14308). The ESU includes all naturally spawned populations of chinook salmon in all river reaches accessible to chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River (NMFS 2000). Chinook salmon (and their progeny) from the following hatchery stocks are considered part of the listed ESU: Chiwawa River (spring run); Methow River (spring run); Twisp River (spring run); Chewuch River (spring run); White River (spring run); and Nason Creek (spring run) (NMFS 2000). Critical habitat was designated February 16, 2000 (65FR7764). This designation includes all river reaches accessible to listed chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River (NMFS 2000). Also included are adjacent riparian zones, river reaches, and estuarine areas in the Columbia River (NMFS 2000). Tribal lands, marine areas, and areas above specified dams and other historical, naturally impassable barriers are excluded (NMFS 2000).

Upper Columbia River spring-run chinook are stream-type salmon. Reaching maturity at four years, chinook in this ESU migrate as subyearlings. Data suggests that they move quickly out of the northeast Pacific and do not migrate up the coast (NMFS 2000a). Substantial life history and genetic differences distinguish fish in this ESU from stream-type spring chinook in the upper-Columbia River.

The upper Columbia River populations were intermixed during the Grand Coulee Fish Maintenance Project (1939 through 1943), resulting in loss of genetic diversity between populations in the ESU (NMFS 1998). Homogenization remains an important feature of the ESU (NMFS 1998). In addition, fish abundance has trended downward both recently and over the long term; at least six former populations from this ESU are now extinct, nearly all existing populations have fewer than 100 wild spawners, and escapements from 1994-96 were the lowest in at least 60 years (NMFS 1998, NMFS 2000).

Habitat degradation remains a factor in the decline of this ESU. Upper Columbia River spring-run chinook must pass up to nine Federal and private dams, with Chief Joseph dam blocking access to historical upstream spawning areas (NMFS 2000a). Urbanization, livestock grazing, and irrigation projects also contribute to spawning and rearing habitat degradation (NMFS 2000a). According to NMFS Biological Opinion on the Operation of the Federal Columbia River Power System, local hatcheries have introduced spring-run chinook but there is little evidence to suggest that these fish stray into wild areas or hybridize with natural species (2000a). However, the 1999 NMFS Federal Register final listing for this ESU states that artificial propagation efforts have had a significant impact on wild chinook, promoting homogenization, the spread of bacterial kidney disease (BKD) from farmed to wild salmon, and the “mining” of wild salmon to replace, or perpetuate, BKD-infected hatchery stock (64FR14323, NMFS 1998). For a more general discussion of factors influencing the decline of chinook salmon ESU’s, see Section 1a: Chinook Salmon, or refer to 63FR11498.

iv. Lower Columbia River Chinook - Threatened

The lower Columbia River chinook ESU was listed as a threatened species on March 24, 1999 (64FR14308). The ESU includes all naturally spawned populations of chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run chinook salmon in the Clackamas River (NMFS 2001a). Critical habitat was designated on February 16, 2000 and includes all river reaches accessible to listed chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon (65FR7764, NMFS 2001a). Also included are adjacent riparian zones, river reaches, and estuarine areas in the Columbia River (NMFS 2001a). Tribal lands, marine areas, and areas above specified dams and other historical, naturally impassable barriers are excluded (NMFS 2001a).

The majority of fall-run fish in this ESU migrate to the marine environment as subyearlings (Reimers and Loeffel 1967, Howell et al. 1985, WDF et al. 1993). Returning adults
that emigrated as yearling smolts may have originated from the extensive hatchery programs in

the ESU (NMFS 2000a). It is also possible that modifications in the river environment have altered the duration of freshwater residence (NMFS 2000a). Coded-wire tag data suggests a northerly migration route, but, based on tag recoveries, the fish contribute more to fisheries off British Columbia and Washington than to the Alaskan fishery (NMFS 2000a).

Though fall-run chinook in this ESU are still present throughout much of their historical range, most of the fish spawning today are first-generation hatchery strays (NMFS 2000a). Hatchery programs begun in the 1870's have released billions of fish into the lower-Columbia (NMFS 2000a). Spring-run populations are severely diminished and extinct from several rivers (NMFS 2000a). Almost all streams with available data exhibit declining abundance (64FR14319). NMFS has surveyed the area and identified a list of streams with primarily native runs of chinook. Two main types occur: “bright” fall-run chinook and “tule” fall-run chinook.

Habitat degradation has affected this ESU through stream blockages, agricultural and forest practices, and urbanization in the Portland and Vancouver areas (64FR14320). Dam construction on the Cowlitz, Lewis, White Salmon, and Sandy Rivers has eliminated access to a substantial portion of the spring-run spawning habitat, with a lesser impact on fall-run habitat (NMFS 1998). Hatcheries have also contributed to the decline of this ESU, causing “straying” and creating competition between wild and hatchery-bred chinook (NMFS 1998).

v. Puget Sound Chinook - Threatened

Puget Sound chinook were listed as a threatened species on March 24, 1999 (64FR14308). This ESU includes all naturally spawned populations of chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington (NMFS 2001b). Chinook salmon and their offspring from the following hatchery stocks are also considered part of this ESU: Kendall Creek (spring run), North Fork Stillaguamish River (summer run), White River (spring run), Dungeness River (spring run), and Elwha River (fall run) (NMFS 2001b). Critical habitat was designated February 16, 2000 (65FR7764). Major river basins know to support this ESU include the Nooksack, Skagit, Stillaguamish, Snohomish, Green/Duwamish, Puyallup, Nisqually, Skokomish, Dungeness, Cedar, and Elwha (65FR7774). Major bays and estuarine marine areas include the South Sound, Hood Canal, Elliot Bay, Possession Sound, Admiralty Inlet, Saratoga Paddage, Rosario Strait, Strait of Georgia, Hara Strait, and the Strait of Juan de Fuca (65FR7774). This designation excludes Indian lands and includes riparian areas.

All Puget Sound ESU chinook are ocean-type. Puget Sound stocks tend to mature at three or four years and share similar ocean migration patterns (63FR11488). Chinook in this ESU differ substantially from Washington coast stocks (63FR11488).

Both long- and short-term trends for Puget Sound chinook stocks are predominantly downward with several populations experiencing severe declines and all spring-run stocks depressed (63FR11494). Habitat in this ESU is severely degraded: upper tributaries have been impacted by forest practices while lower tributaries and mainstem rivers have been impacted by agricultural practices and urbanization (63FR11494). Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects create major habitat problems in a number of basins (63FR11494). In addition, changes in flow regime, sedimentation, high temperatures, streambed instability, estuarine loss, loss of large woody debris, loss pf pool habitat, and blockage negatively impact habitat in many basins (Bishop and Morgan 1996).

Hatchery fish and harvest also affect chinook stocks in this ESU. Hatchery populations result in an increased risk of loss of fitness and genetic diversity among populations (63FR11494). Harvest impacts on salmon stocks are quite high, with total exploitations on some stocks exceeding 90% (PSC 1994). Four stocks are extinct, another four stocks are possibly extinct, and six stocks are at a high risk of extinction (Nehlsen 1991). NMFS has concluded that salmon in this ESU are not currently in danger of extinction but are likely to become endangered in the future (63FR11495).

vi. Upper Willamette River Chinook - Threatened

The Upper Willamette River ESU was listed as a threatened species on March 24, 1999 (64FR14308). The ESU includes all native populations of spring-run chinook salmon in the Clackamas River and in the Willamette River and its tributaries above Willamette Falls, Oregon (NMFS 2001c). Fall-run chinook above Willamette Falls are introduced and not considered as a population in this ESU (63FR11489). Critical habitat was designated February 16, 2000 (65FR7764) and includes all river reaches accessible to listed chinook salmon in the Clackamas River and the Willamette River and its tributaries above Willamette Falls (NMFS 2001c). Riparian zones are included in this designation, as are river reaches and estuarine areas in the Columbia River (NMFS 2001c). Tribal lands and areas above specific dams or historic, natural, impassable barriers are excluded (NMFS 2001c).

Chinook in this ESU differ significantly from those of adjacent ESUs (NMFS 2000a). Chinook in the upper Willamette ESU share traits from both ocean and stream type development strategies, migrating to the marine waters off British Columbia and Alaska and maturing in their fourth or fifth years (NMFS 2000a).

Through human activity, habitat in the Willamette has become highly simplified through channelization, dredging, and other activities that have reduced shoreline and, thus, rearing habitat by up to 75% (NMFS 2000a). The construction of 37 dams in the basin has blocked access to over 700 kilometers of stream and river spawning habitat and altered the temperature regime of the Willamette and its tributaries, in turn affecting the development of eggs and fry (NMFS 2000a). In addition, agricultural and forestry practices, pollution, and urbanization contribute to degraded water quality. Hatchery production also affects native stocks, with estimates for the total proportion of escapement which are hatchery fish ranging from two-thirds to 90% (NMFS 2000a, 63FR11495). Harvest rates have declined, but remain high (NMFS 2000a).

NMFS has stated that chinook in this ESU are not presently in danger of extinction but are likely to become so in the future (63FR11496). Total abundance has been relatively stable at 20,0000 to 30,0000 fish, though native escapement is less than 5,000 fish and is declining sharply (63FR11496). Currently, the only significant natural production of spring-run chinook in this ESU is in the McKenzie River basin (64FR14315).

b. Chum Salmon *(Oncorhynchus keta)*

The following life history information is taken from 63FR11774, March 10, 1998.

Chum salmon belong to the family Salmonidae and are one of eight species of Pacific salmonids in the genus *Oncorhynchu*s. Chum salmon are semelparous (spawn only once then die), spawn primarily in fresh water, and apparently exhibit obligatory anadromy, as there are no recorded landlocked or naturalized freshwater populations (Randall et al. 1987). The species is best known for the enormous canine-like fangs and striking body color (a calico pattern, with the anterior two-thirds of the flank marked by a bold, jagged, reddish line and the posterior third by a jagged black line) spawning males. Females are less flamboyantly colored and lack the extreme dentition of the males. The species has the widest natural geographic and spawning distribution of any Pacific salmonid, primarily because its range extends farther along the shores of the Arctic Ocean than that of the other salmonids (Groot and Margolis 1991). Chum salmon have been documented to spawn from Korea and the Japanese island of Honshu, east, around the rim of the North Pacific Ocean, to Monterey Bay in southern California. The species' range in the Arctic Ocean extends from the Laptev Sea in Russia to the Mackenzie River in Canada (Bakkala 1970; Fredin et al. 1977). Historically, chum salmon were distributed throughout the coastal regions of western Canada and the United States, as far south as Monterey, California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast. Chum salmon may historically have been the most abundant of all salmonids. Neave (1961) estimated that, prior to the 1940s, chum salmon contributed almost 50 percent of the total biomass of all salmonids in the Pacific Ocean. Chum salmon also grow to be among the largest of Pacific salmon, second only to chinook salmon in adult size, with individuals reported up to 108.9 cm in length and 20.8 kg in weight (Pacific Fisherman, 1928). Average size for the species is around 3.6 to 6.8 kg (Salo, 1991).

Chum salmon usually spawn in coastal areas, and juveniles outmigrate to seawater almost immediately after emerging from the gravel that covers their redds (Salo 1991). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus *Oncorhynchus* (e.g., coastal cutthroat trout, steelhead, coho salmon, and most types of chinook and sockeye salmon), which usually migrate to sea at a larger size, after months or years of freshwater rearing. This means that survival and growth in juvenile chum salmon depend less on freshwater conditions (unlike stream-type salmonids which depend heavily on freshwater habitats) than on favorable estuarine and marine conditions. Another behavioral difference between chum salmon and most species that rear extensively in fresh water is that chum salmon form schools, presumably to reduce predation (Pitcher 1986), especially if their movements are synchronized to swamp predators (Miller and Brannon 1982).

Age at maturity appears to follow a latitudinal trend in which a greater number of older fish occur in the northern portion of the species' range. Age at maturity has been investigated in many studies, and in both Asia and North America, it appears that most chum salmon (95 percent) mature between 3 and 5 years of age, with 60 to 90 percent of the fish maturing at 4 years of age. However, a higher proportion of 5-year-old fish occurs in the north, and a higher proportion of 3-year-old fish occurs in the south (southern British Columbia, Washington, Oregon) (Gilbert 1922;Marr 1943; Pritchard 1943; Kobayashi 1961; Oakley 1966; Sano 1966). Helle (1979) has shown that the average age maturity in Alaska is negatively correlated with growth during the second year of marine life, but not with growth in the first year, and that age at maturity is negatively correlated with year-class strength. A few populations of chum salmon also show an alternation of dominance between 3 to 4 year-old fish, usually in the presence of dominant year classes of pink salmon (Gallagher 1979). Chum salmon usually spawn in the lower reaches of rivers typically within 100 km of the ocean. Redds are usually dug in the mainstem or in side channels of rivers. In some areas (particularly in Alaska and northern Asia), they typically spawn where upwelled groundwater percolates through the redds (Bakkala 1970; Salo 1991). Chum salmon are believed to spawn primarily in the lower reaches of rivers because they usually show little persistence in surmounting river blockages and falls. However, in some systems, such as the Skagit River, Washington, chum salmon routinely migrate over long distances upstream (at least 170 km in the Skagit River) (Hendrick 1996). In two other rivers, the species swims a much greater distance. In the Yukon River, Alaska, and the Amur River, between China and Russia, chum salmon migrate more than 2,500 km inland. Although these distances are impressive, both rivers have low gradients and are without extensive falls or other blockages to migration. In the Columbia River Basin, there are reports that chum salmon may historically have spawned in the Umatilla and Walla Walla Rivers, more than 500 km from the sea (Nehlsen et al. 1991). However, these fish would have had to pass Celilo Falls, a web of rapids and cascades, which presumably were passable by chum salmon only at high water flows.

During the spawning migration, adult chum salmon enter natal river systems from June to March, depending on characteristics of the population or geographic location. Groups of fish entering a river system at particular times or seasons are often called ‘‘runs’’, and run timing has long been used by the fishing community to distinguish anadromous populations of salmon, steelhead, and sea-run cutthroat trout. Run timing designations (e.g., summer versus fall or early-fall versus late-fall) are important in this status review because two of the ESA petitions for chum salmon (PRO-Salmon 1994; Trout Unlimited 1994) used run timing as evidence supporting population distinction. In Washington, a variety of seasonal runs are recognized, including summer, fall, and winter populations. Fall-run fish predominate, but summer runs are found in Hood Canal, the Strait of Juan de Fuca, and in southern Puget Sound (Washington Department of Fisheries (WDF) et al. 1993). Only two rivers have fish returning so late in the season that the fish are designated as winter-run fish, and both of these are in southern Puget Sound.

i. Columbia River - Threatened

The Columbia River chum salmon ESU was listed as a threatened species on March 25, 1999 and includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon (NMFS 2000b). Critical habitat was designated February 16, 2000 and includes "all river reaches accessible to listed chum salmon (including estuarine areas and tributaries) in the Columbia River downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens" (NMFS 2000b). Also included are adjacent riparian zones. Excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years)" (NMFS 2000b). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 4,426 square miles in Oregon and Washington and the following counties lie partially or wholly within these basins (or contain migration habitat for the species): Oregon - Clatsop, Columbia, Multnomah, and Washington; Washington - Clark, Cowlitz, Lewis, Pacific, Skamania, and Wahkiakum (NMFS 2000b). Three streams on the Washington side of the river (Hamilton and Hardy Creeks near Bonneville Dam and the Grays River) support native spawning populations while about 23 small native populations have been identified from streams on the Oregon side of the river (US ACE 2000).

A NMFS memorandum states, "Historically, chum salmon were abundant in the lower reaches of the Columbia River and may have spawned as far upstream as the Walla Walla River (over 500 km inland). Today only remnant chum salmon populations exist, all in the lower Columbia River. They are few in number, low in abundance, and of uncertain stocking history... Little artificial propagation of chum salmon has occurred in the Columbia River compared to other areas in the Pacific Northwest, and this has usually been conducted in areas that no longer contain native chum salmon stocks. From 1930 to 1991 an average of only 485,000 chum salmon fry were released annually. Historically, chum salmon were reported to be present in almost every river in the lower Columbia River Basin, but most of these runs disappeared by the 1950s (Rich 1942, Marr 1943, Fulton 1970). Presently, on the Washington side of the lower Columbia River, only three streams are recognized as containing native chum salmon: Hamilton and Hardy Creeks near Bonneville Dam at RKm 235, and Grays River (RKm 34) (WDF et al. 1993).

Historical plants of non-native hatchery chum salmon into the Columbia River Basin (comprised of fish from the coast, Hood Canal, and a small portion of Japanese origin) are believed by the WDFW not to have hybridized with local populations for several reasons. Hatchery fish were planted to supplement fisheries only in areas without native chum salmon and in areas where spawning was poor or nonexistent (WDF et al. 1993). Recent genetic analysis of fish from Hardy and Hamilton Creeks and from the Grays River also indicate that these fish are genetically distinct from other chum salmon populations in Washington (WDF et al. 1993, Phelps et al. 1994). At present, only a single cooperatively owned hatchery on the Chinook River (a tributary to the Columbia) produces hatchery chum salmon for the Columbia River and propagates chum salmon imported from Willapa Bay. Approximately 360,500 chum salmon fry were released annually by this hatchery between 1982 and 1991 (WDF et al. 1993).

About 22 populations of chum salmon have been reported on the Oregon side of the Columbia River (Kostow 1995). Big Creek and the Klaskanine River (the latter a tributary to the Youngs River near Olney, OR) are the only river systems that have received significant numbers of hatchery chum salmon, and in both cases, local fish were used for supplementation (NRC 1995).

Although current abundance is only a small fraction of historical levels, and much of the original inter-populational diversity has presumably been lost, the total spawning run of chum salmon to the Columbia River has been relatively stable since the mid 1950s, and total natural escapement for the ESU is probably at least several thousand fish per year. Taking all of these factors into consideration, about half of the NMFS Biological Review Team (BRT) members concluded that this ESU is at significant risk of extinction; the remainder concluded that the short-term extinction risk was not as high, but that the ESU is at risk of becoming endangered." (Johnson 1997).

ii. Hood Canal Summer - Threatened

The Hood Canal summer-run chum salmon ESU was listed as a threatened species on March 25, 1999 and includes all naturally spawned populations of summer-run chum salmon in Hood Canal and it tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington (NMFS 2000c). Critical habitat was designated on February 16, 2000 and "includes all river reaches accessible to listed chum salmon (including estuarine areas and tributaries) draining into Hood Canal as well as Olympic Peninsula rivers between and including Hood Canal and Dungeness Bay, Washington" (NMFS 2000c). Adjacent riparian zones and estuarine and/or marine areas of Hood Canal, Admiralty Inlet, and the Straits of Juan De Fuca to the international boundary and as far west as a straight line extending north from Dungeness Bay are also included; excluded are tribal lands and areas above specific dams or above longstanding, naturally impassable barriers (i.e.,natural waterfalls in existence for at least several hundred years) (NMFS 200c). Major river basins containing spawning and rearing habitat for this ESU comprise approximately 1,753 square miles in Washington and the following counties lie partially or wholly within these basins (or contain migration habitat for the species): Clallam, Island, Jefferson, Kitsap, and Mason (NMFS 200c).

A NMFS memorandum states, "Hood Canal summer-run chum salmon are defined in the [salmon and steelhead stock inventory] SASSI (WDF et al. 1993) as fish that spawn from mid-September to mid-October. Fall-run chum salmon are defined as fish that spawn from November through December or January. Run-timing data from as early as 1913 indicated temporal separation between summer and fall chum salmon in Hood Canal. Even though for many years there have been hatchery releases of fall chum salmon in Hood Canal of about 35 million fish annually, and many of these fish return to hatcheries in Hood Canal and were historically spawned before the end of October, recent spawning surveys show that temporal separation still exists between summer and fall chum salmon. Genetic data indicate strong and long-standing reproductive isolation between chum salmon in this ESU and other chum salmon populations in the United States and British Columbia. Hood Canal is also geographically separated from other areas of Puget Sound, the Strait of Georgia, and the Pacific Coast.

In general, summer-run chum salmon are most abundant in the northern part of the species' range, where they spawn in the main stems of rivers. Farther south, water temperatures are so high and stream flows are often so low during late summer and early fall that conditions become unfavorable for salmonids. River flows typically do not increase and water temperatures do not decrease until the arrival of fall rains in late October/November. Presumably for these reasons, few summer chum populations are recognized south of northern British Columbia. Ecologically, summer-run chum salmon populations from Washington must return to freshwater and spawn during peak periods of high water temperature, suggesting an adaptation to specialized environmental conditions that allow this life-history strategy to persist in an otherwise inhospitable environment. The BRT concluded, therefore, that these populations contribute substantially to the ecological/genetic diversity of the species as a whole.

Some chum salmon populations in the Puget Sound/Strait of Georgia ESU, which has four recognized summer-run populations and two recognized winter-run populations, also exhibit unusual run timing. However, allozyme data indicate that these populations are genetically closely linked to nearby fall-run populations. Therefore, variation in run timing has presumably evolved more than once in the southern part of the species' range. Genetic data indicate that summer-run populations from Hod Canal and the Strait of Juan de Fuca are part of a much more ancient lineage than summer-run chum salmon in southern Puget Sound.

The BRT concluded that this ESU is in danger of extinction. In 1994, when petitions were filed with NMFS to list summer chum salmon in Hood Canal, of 12 streams in Hood Canal identified by the petitioners as recently supporting spawning populations of summer chum salmon, 5 may already have become extinct, 6 of the remaining 7 showed strong downward trends in abundance, and all were at low levels of abundance. The populations in Discovery Bay and Sequim Bay were also at low levels of abundance with declining trends. Threats to the continued existence of these populations include degradation of spawning habitat, low water flows, and incidental harvest in salmon fisheries in the Strait of Juan de Fuca and coho salmon fisheries in Hood Canal.

In 1995 and 1996, new information was supplied by WDFW (1996) and by the USFWS (1996) that demonstrated substantial increases of returning summer chum to some streams. A hatchery program initiated in 1992 at the Quilcene National Fish Hatchery was at least partially responsible for adult returns to the Quilcene River system, but it appears that 1996 spawners returning to other streams in Hood Canal were primarily (and perhaps entirely) the result of natural production. These streams (e.g., the Duckabush, Hamma Hamma, and Dosewallips) have thus demonstrated considerable resilience in rebounding dramatically from very depressed levels of abundance in recent years.

The rapid increase of summer-run populations in northern Hood Canal following the reduction in incidental harvest in 1991 and 1992 is considerably more encouraging than the lack of response of Columbia River and Tillamook Bay populations even though directed fisheries were eliminated in those areas many years ago.

There remain, however, serious concerns about the overall health of this ESU. First, the population increases were limited in geographic extent, occurring only in streams on the west side of Hood Canal. Several streams on the eastern side of Hood Canal continue to have no spawners at all, and even returns to the Union River were down in 1996. Union River, located at the southeastern end of the Canal, was classified as a healthy stock by WDFW in the SASSI report. In the Strait of Juan de Fuca portion of this ESU, only one of three creeks that have recently contained summer chum salmon runs showed an increase in adult returns in 1996. Second, the strong returns to the west-side streams were the result of a single strong year class (1992), which returned as 3-year-old fish in 1995 and as 4-year-old fish in 1996. Also, the declines in most of these populations have been severe and have spanned two decades. Coastwide, many chum salmon populations had unusually large returns in 1995 and 1996, but there is no indication from the historical record to suggest that such high productivity can be sustained. In addition, in this ESU, summer chum salmon populations have shown a great deal of variability in productivity and run size in recent years, and this extreme variability can itself be a significant risk factor.

Third, greatly reduced incidental harvest rates in recent years probably contributed to the increased abundance in west-side Hood Canal streams. However, these reductions have been implemented because of greatly reduced abundances of the target species (coho salmon), rather than as a conservation measure for summer chum salmon. If coho salmon in the area rebound, and fishery management policies are not implemented to protect summer-run chum salmon, these populations would again face high levels of incidental harvest. Finally, harvest of summer chum salmon in Strait of Juan de Fuca fisheries is primarily incidental to targeted harvest of Fraser River sockeye salmon. If the run of Fraser River sockeye in the Strait of Juan de Fuca is strong, and abundance of summer chum salmon is low, the relative impact of incidental take in the fishery will be stronger on this ESU than it has been in recent years.

In conclusion, although the BRT agreed that the 1995-96 data on summer chum salmon from this ESU provided a more encouraging picture than was the case in 1996, most members concluded that this ESU was still at significant risk of extinction. A major factor in this conclusion was that, in spite of strong returns to some streams, summer chum salmon were either extinct or at very low abundance in more than half of the streams in this ESU that historically supported summer-run populations. A minority of the BRT concluded that the new data indicated somewhat less risk of extinction, but that the ESU was still likely to become endangered in the foreseeable future. Only one member believed that the large returns to some Hood Canal streams indicated that this ESU as a whole was not at significant extinction risk" (Johnson 1997).

c. Sockeye Salmon *(Oncorhynchus nerka)*

The following life history information is taken from 63FR11750, March 10, 1998.

Sockeye salmon belong to the family Salmonidae and are one of seven species of Pacific salmonids in the genus Oncorhynchus. Sockeye salmon are anadromous, meaning they migrate from the ocean to spawn in fresh water. They are the third most abundant of the seven species of Pacific salmon, after pink and chum salmon. Unique in their appearance, the adult spawners typically turn bright red, with a green head, hence “red” salmon, as commonly called in Alaska. During the ocean and adult migratory phase sockeye often have a bluish back and silver sides, giving rise to another common name, ``bluebacks.'' The name “sockeye” is thought to have been a corruption of the various Indian tribes'' word ``sukkai.'' Sockeye salmon exhibit a wide variety of life history patterns that reflect varying dependency on the fresh water environment. With the exception of certain river-type and sea-type populations, the vast majority of sockeye salmon spawn in or near lakes, where the juveniles rear for 1 to 3 years prior to migrating to sea. For this reason, the major distribution and abundance of large sockeye salmon stocks are closely related to the location of rivers that have accessible lakes in their watersheds for juvenile rearing (Burgner, 1991). On the Pacific coast, sockeye salmon inhabit riverine, marine, and lake environments from the Columbia River and its tributaries north and west to the Kuskokwim River in western Alaska (Burgner, 1991). There are also O. nerka life forms that are non-anadromous, meaning that most members of the form spend their entire lives in freshwater. Non-anadromous O. nerka in the Pacific Northwest are known as kokanee. Occasionally, a proportion of the juveniles in an anadromous sockeye salmon population will remain in their rearing lake environment throughout life and will be observed on the spawning grounds together with their anadromous siblings. Ricker (1938) defined the terms “residual sockeye” and “residuals” to identify these resident, non-migratory progeny of anadromous sockeye salmon parents.

Among the Pacific salmon, sockeye salmon exhibit the greatest diversity in selection of spawning habitat and great variation in river entry timing and the duration of holding in lakes prior to spawning. The vast majority of sockeye salmon typically spawn in inlet or outlet tributaries of lakes or along the shoreline of lakes where upwelling of oxygenated water through gravel or sand occurs. However, they may also spawn in (1) suitable stream habitat between lakes, (2) along the nursery lakeshore on outwash fans of tributaries or where upwelling occurs along submerged beaches, and (3) along beaches where the gravel or rocky substrate is free of fine sediment and the eggs can be oxygenated by wind-driven water circulation. All of these spawning habitats may be used by these “lake-type” sockeye salmon.

Growth influences the duration of stay in the nursery lake and is influenced by intra- and interspecific competition, food supply, water temperature, thermal stratification, migratory movements to avoid predation, lake turbidity, and length of the growing season. Lake residence time usually increases the farther north a nursery lake is located. In Washington and British Columbia, lake residence is normally 1 or 2 years, whereas in Alaska some fish may remain 3 or, rarely, 4 years in the nursery lake, prior to smoltification (Burgner, 1991; Halupka et al., 1993). Adaptation to a greater degree of utilization of lake environments for both adult spawning and juvenile rearing has resulted in the evolution of complex timing for incubation, fry emergence, spawning, and adult lake entry that often involves intricate patterns of adult and juvenile migration and orientation not seen in other Oncorhynchus species (Burgner, 1991).

Upon emergence from the substrate, sockeye salmon alevins exhibit a varied behavior that appears to reflect local adaptations to spawning and rearing habitat. For example, lake-type sockeye salmon juveniles move either downstream or upstream to rearing lakes. Periods of streambank holding are limited for most juvenile sockeye salmon, as emergents in streams above or between connecting lakes use the current to travel to the nursery lake. Predation on migrating sockeye salmon fry varies considerably with spawning location (lakeshore beach, creek, river, or spring area). Sockeye salmon fry mortality due to predation by other fish species and birds can be extensive during downstream and upstream migration to nursery lake habitat and is only partially reduced by the nocturnal migratory movement of some fry populations (Burgner, 1991). Juveniles emerging in streams downstream from a nursery lake can experience periods of particularly high predation compared with other juvenile sockeye. Juvenile sockeye salmon in lakes are visual predators, feeding on zooplankton and insect larvae (Foerster, 1968; Burgner, 1991). Smolt migration typically occurs between sunset and sunrise, beginning in late April and extending through early July, with southern stocks migrating the earliest.

Sockeye salmon also spawn in mainstem rivers without juvenile lake-rearing habitat (Foerster, 1968; Burgner, 1991). These are referred to as “river-type” and “sea-type”' sockeye salmon. In areas where lake-rearing habitat is unavailable or inaccessible, sockeye salmon may utilize river and estuarine habitat for rearing or may forgo an extended freshwater rearing period and migrate to sea as underyearlings (Birtwell et al., 1987; Wood et al., 1987a; Heifitz et al., 1989; Murphy et al., 1988, 1989, and 1991; Lorenz and Eiler, 1989; Eiler et al., 1992; Levings et al., 1995; and Wood, 1995). Riverine spawners that rear in rivers for 1 or 2 years are termed ``river-type'' sockeye salmon. Riverine spawners that migrate as fry to sea or to lower river estuaries in the same year, following a brief freshwater rearing period of only a few months, are referred to as ``sea-type'' sockeye salmon. River-type and sea-type sockeye salmon are common in northern areas and may predominate over lake-type sockeye salmon in some river systems (Wood et al., 1987a; Eiler et al., 1988; Halupka et al., 1993; Wood, 1995).

Once in the ocean, sockeye salmon feed on copepods, euphausiids, amphipods, crustacean larvae, fish larvae, squid, and pteropods. The greatest increase in length is typically in the first year of ocean life, whereas the greatest increase in weight is during the second year. Northward migration of juveniles to the Gulf of Alaska occurs in a band relatively close to shore, and offshore movement of juveniles occurs in late autumn or winter. Among other Pacific salmon, sockeye salmon prefer cooler ocean conditions (Burgner, 1991). Lake- or river-type will spend from 1 to 4 years in the ocean before returning to freshwater to spawn.

Adult sockeye salmon home precisely to their natal stream or lake habitat (Hanamura, 1966; Quinn, 1985; and Quinn et al., 1987). Stream fidelity in sockeye salmon is thought to be adaptive, since this ensures that juveniles will encounter a suitable nursery lake. Wood (1995) inferred from protein electrophoresis data that river- and sea-type sockeye salmon have higher straying rates within river systems than lake-type sockeye salmon.

i. Snake River Sockeye Salmon - Endangered

Snake River sockeye were listed as an endangered species on November 20, 1991, and includes populations of sockeye salmon from the Snake River Basin, Idaho (extant populations occur in the Stanley River subbasin) (NMFS 2000d). Critical habitat was designated on December 28, 1993 and includes “river reaches presently or historically accessible (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams) to Snake River sockeye salmon in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) and including all Columbia River estuarine areas and river reaches upstream to the confluence of the Columbia and Snake Rivers; all Snake River reaches from the confluence of the Columbia River upstream to the confluence of the Salmon River; all Salmon River reaches from the confluence of the Snake River upstream to Alturas Lake Creek; Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks); Alturas Lake Creek, and that portion of Valley Creek between Stanley Lake Creek and the Salmon River. Watersheds containing spawning and rearing habitat for this ESU comprise approximately 510 square miles in Idaho.

Johnson and Waples have conducted a status review of the Snake River ESU for NMFS. They state, “Sockeye salmon (Oncorhynchus nerka) are native to the Snake River and historically were abundant in several lake systems in Idaho and Oregon. In this century, a variety of factors (including overfishing, irrigation diversions, obstacles to migrating fish, and eradication through poisoning) have led to the demise of all Snake River sockeye salmon except those returning to Redfish Lake in the Stanley Basin of Idaho. Following recent declines in that population as well, the Shoshone-Bannock tribe of Idaho petitioned the National Marine Fisheries Service (NMFS) to list Snake River sockeye salmon as an endangered "species"under the U.S. Endangered Species Act (ESA)” (Johnson and Waples 1991).

Historically, in the Columbia River Basin sockeye salmon migrated to Osoyoos Lake in the Okanogan River Basin, Wenatchee Lake in the Wenatchee River Basin and Redfish Lake in Idaho. Today, Redfish Lake remains the only sockeye lake that is still accessible in the Snake River Basin. Snake River sockeye spawn on the shoals of Redfish Lake in the fall, and fry emerge in the spring. Returns to Redfish Lake between 1989-1994 have numbered fewer than ten fish.

ii. Ozette Lake - Threatened

Ozette Lake sockeye were listed as a threatened species on March 25, 1999 and this ESU includes all naturally spawned populations of sockeye salmon in Ozette Lake and streams and tributaries flowing into Ozette Lake, Washington (NMFS 2000e). Critical habitat was designated on February 16, 2000 and includes all lake areas and river reaches (including adjacent riparian zones) accessible to listed sockeye salmon in Ozette Lake, located in Clallam County, Washington; excluded are areas above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years) as well as tribal lands (NMFS 2000e). Watersheds containing spawning and rearing habitat for this ESU comprise approximately 88 square miles in Washington and are located in Clallam County (NMFS 2000e).

The Ozette Lake ESU consists of sockeye salmon that return to Ozette Lake through the Ozette River and spawn primarily in this lake (Flagg et al. 1998). Gustafson et al. state that "a combination of past overfishing and spawning habitat degradation, due to stream and tributary outwash fan siltation, associated with timber harvest and road building, have been cited as major causes of this stock's decline" (Gustafson et al. 1997). The perceived risk to this ESU ranges from low to moderate in terms of variable ocean productivity, for downward trends and population fluctuations, and moderate to increasing for abundance considerations (Flagg et al. 1998).

d. Steelhead *(Oncorhynchus mykiss)*

The following life history information is taken from EPA 2000 (50 CFR Parts 222 and 227 and 63FR11797).

Steelhead exhibit one of the most complex life histories of any salmonid species. Steelhead may exhibit anadromy or freshwater residency. Resident forms are usually referred to as "rainbow" or "redband" trout, while anadromous life forms are termed "steelhead".

Steelhead typically migrate to marine waters after spending 2 years in freshwater. They then reside in marine waters for 2 to 3 years prior to returning to their natal stream to spawn as 4- or 5- year-olds. Depending on water temperature, steelhead eggs may incubate in redds for 1.5 to 4 months before hatching as alevins (larval stage dependent on yolk sac as food). Following yolk sac absorption, alevins emerge from the gravel as young juveniles (fry) and begin actively feeding. Juveniles rear in freshwater from 1 to 4 years, then migrate to the ocean as smolts.

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration. These two ecotypes are termed "stream maturing" and "ocean maturing". Stream maturing steelhead return to freshwater in a sexually immature condition and require several months to mature and spawn. Ocean maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry (i.e., summer and winter steelhead).

Two major genetic groups or "subspecies" of steelhead occur on the west coast of the United States: a coastal group and an inland group, separated on the Fraser and Columbia River Basins by the Cascade crest. Historically, steelhead likely inhabited most coastal streams in Washington, Oregon, and California, as well as many inland streams in these states and Idaho. However, during this century, over 23 indigenous, naturally-reproducing stocks of steelhead are believed to have been extirpated, and many more are thought to be in decline in numerous coastal and inland streams.

Factors contributing to the decline of specific steelhead ESUs are discussed under each ESU. General information for west coast steelhead is summarized here. Forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented habitat. Water diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat. Washington and Oregon's wetlands are estimated to have diminished by one-third. Loss of habitat complexity as seen in the decrease of abundance of large, deep pools due to sedimentation and loss of pool-forming structures has also adversely affected west coast steelhead (an 80 percent loss for Oregon).

Steelhead are not generally targeted in commercial fisheries but do support an important recreational fishery throughout their range. A particular problem occurs in the main stem of the Columbia River where listed steelhead from the Middle Columbia River ESU are subject to the same fisheries as unlisted, hatchery-produced steelhead, chinook and coho salmon. Infectious disease and predation also take their toll on steelhead. Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous river systems. Federal and state land management practices have not been effective in stemming the decline in west coast steelhead

i. Upper Columbia River Basin - Endangered

The following life history information is taken from EPA 1998 (50 CFR Parts 222 and 227 and 62FR43937).

This inland steelhead ESU occupies the Columbia River Basin upstream from the Yakima River, Washington, to the U.S./Canada border. The geographic area occupied by the ESU forms part of the larger Columbia Basin Ecoregion. This ESU received an endangered listing on 18 August 1997 (62FR43937). Official critical habitat was designated February 16, 2000. Mullan et al. (1992, 50 CFR Parts 222 and 227) described this area as a harsh environment for fish and stated that "it should not be confused with more studied, benign, coastal streams of the Pacific Northwest.

NMFS cites a pre-fishery run size estimate in excess of 5000 adults for tributaries above Rock Island Dam. Runs may have already been depressed by lower Columbia River fisheries at the time of the early estimates (1933-1959). Most of the escapement to naturally spawning habitat within the range of this ESU is to the Wenatchee River, and the Methow and Okanogan Rivers. The Entiat River also has a small spawning run. Steelhead in the Upper Columbia river ESU continue to exhibit low abundances, both in absolute numbers and in relation to numbers of hatchery fish throughout the region. Estimates of natural production of steelhead in the ESU are will below replacement (approximately 0.3:1 adult replacement ratios estimated in the Wenatchee and Entiat Rivers). The proportion of hatchery fish is high in these rivers (65-80 percent) with extensive mixing of hatchery and natural stocks.

Life history characteristics for UCRB steelhead are similar to those of other inland steelhead ESUs. However, some of the oldest smolt ages for steelhead, up to 7 years, are reported from this ESU; this may be associated with the cold stream temperatures (Mullan et al., 1992, 50 CFR Parts 222 and 227). Based on limited data available from adult fish, smolt age in this ESU is dominated by 2-year-olds. Steelhead from the Wenatchee and Entiat Rivers return to freshwater after 1 year in salt water, whereas Methow River steelhead are primarily 2-ocean resident (i.e., 2 years in salt water) (Howell et al., 1985 IN: 50 CFR Parts 222 and 227).

In an effort to preserve fish runs affected by Grand Coulee Dam (blocked fish passage in 1939), all anadromous fish migrating upstream were trapped at Rock Island Dam (Rkm 729) from 1939 through 1943 and either released to spawn in tributaries between Rock Island and Grand Coulee Dams or spawned in hatcheries and the offspring released in that area (Mullan et al., 1992; Chapman et al., 1994 IN: 50 CFR Parts 222 and 227). Through this process, stocks of all anadromous salmonids, including steelhead, which historically were native to several separate sub-basins above Rock Island Dam, were randomly redistributed among tributaries in the Rock Island-Grand Coulee reach. Exactly how this has affected stock composition of steelhead is unknown.

Habitat degradation, juvenile and adult mortality in the hydrosystem, and unfavorable environmental conditions in both marine and freshwater habitats have contributed to the declines and represent risk factors for the future. Harvest in lower river fisheries and genetic homogenization from composite broodstock collection are other factors that may contribute significant risk to the Upper Columbia ESU.

ii. Snake River Basin - Threatened

The following information is taken from EPA 1998 (50 CFR Parts 222 and 227 and 62FR43937).

This inland steelhead ESU occupies the Snake River Basin of southeast Washington, northeast Oregon and Idaho. A final listing status of threatened was issued on 18 August 1997 (62FR43937) for the spawning range upstream from the confluence with the Columbia River. Critical habitat was designated on February 16, 2000. The Snake River flows through terrain that is warmer and drier on an annual basis than the upper Columbia Basin or other drainages to the north. Geologically, the land forms are older and much more eroded than most other steelhead habitat. Collectively, the environmental factors of the Snake River Basin result in a river that is warmer and more turbid, with higher pH and alkalinity, than is found elsewhere in the range of inland steelhead.

SRB steelhead are all defined as “B-run” steelhead. Prior to completion of the Ice Harbor dam in 1962, there were no counts of naturally spawned Snake River basin steelhead. From 1949 to 1971 counts averaged about 40,000 steelhead for the Clearwater River. At Ice Harbor Dam, counts averaged approximately 70,000 until 1970. The natural component for steelhead escapements above Lower Granite Dam was about 9400 (2400 B-run) from 1990-1994. SRB steelhead recently suffered severe declines in abundance relative to historical levels. Low run sizes over the last 10 years are most pronounced for naturally produced steelhead. The drop in parr densities characterizes many river basins in this region as being underseeded relative to the carrying capacity of streams. Declines in abundance have been particularly serious for B-run steelhead, increasing the risk that some of the life history diversity may be lost from steelhead in this ESU.

Hatchery/natural interactions that occur for SRB steelhead are of concern because many of the hatcheries use composite stocks that have been domesticated over a long period of time. The primary indicator of risk to the ESU is declining abundance throughout the region.

SRB steelhead are summer steelhead, as are most inland steelhead, and comprise two groups, A-run and B-run, based on migration timing, ocean-age, and adult size. SRB steelhead enter freshwater from June to October and spawn in the following spring from March to May. A-run steelhead are thought to be predominately 1-ocean (one year at sea), while B-run steelhead are thought to be 2-ocean (IDFG 1994 IN: 50 CFR Parts 222 and 227). SRB steelhead usually smolt at age 2- or 3-years (Whitt, 1954; BPA, 1992; Hassemer, 1992 IN: 50 CFR Parts 222 and 227).

The steelhead population from Dworshak National Fish Hatchery is the most divergent single population of inland steelhead based on genetic traits determined by protein electrophoresis; these fish are consistently referred to as B-run.

Similar factors to those affecting other salmonids are contributing to the decline of SRB steelhead. Widespread habitat blockage from hydrosystem management and potentially deleterious genetic effects from straying and introgression from hatchery fish. The reduction in habitat capacity resulting from large dams such as the Hells Canyon dam complex and Dworshak Dam is somewhat mitigated by several river basins with fairly good production of natural steelhead runs.

iii. Upper Willamette River - Threatened

The following life history information is taken from EPA 1998 (63FR11797).

On March 25, 1999 the Upper Willamette River steelhead ESU was listed as threatened. Critical habitat was designated on February 16, 2000. This coastal ESU occupies the Willamette River and its tributaries, upstream from Willamette Falls. The Willamette River Basin is zoogeographically complex. In addition to its connection to the Columbia River, the Willamette River historically has had connections with coastal basins through stream capture and headwater transfer events.

Steelhead from the upper Willamette River are genetically distinct from those in the lower river. Reproductive isolation from lower river populations may have been facilitated by Willamette Falls, which is known to be a migration barrier to some anadromous salmonids. For example, winter steelhead and spring chinook salmon (*O. tshawytscha*) occurred historically above the falls, but summer steelhead, fall chinook salmon, and coho salmon did not.

Steelhead in the Upper Willamette ESU are distributed in a few, relatively small, natural populations. Over the past several decades, total abundance of natural late-migrating winter steelhead ascending the Willamette Falls fish ladder has fluctuated several times over a range of approximately 5,000-20,000 spawners. However, the last peak occurred in 1988, and this peak has been followed by a steep and continuing decline. Abundance in each of the last five years (to 1998) has been below 4,300 fish, and the run in 1995 was the lowest in 30 years. The low abundance, coupled with potential risks associated with interactions between naturally spawned steelhead and hatchery stocks is of great concern to NMFS.

The native steelhead of this basin are late-migrating winter steelhead, entering freshwater primarily in March and April, whereas most other populations of west coast winter steelhead enter freshwater beginning in November or December. As early as 1885, fish ladders were constructed at Willamette Falls to aid the passage of anadromous fish. As technology improved, the ladders were modified and rebuilt, most recently in 1971. These fishways facilitated successful introduction of Skamania stock summer steelhead and early-migrating Big Creek stock winter steelhead to the upper basin. Another effort to expand the steelhead production in the upper Willamette River was the stocking of native steelhead in tributaries not historically used by that species. Native steelhead primarily used tributaries on the east side of the basin, with cutthroat trout predominating in streams draining the west side of the basin.

Nonanadromous *O. mykiss* are known to occupy the Upper Willamette River Basin; however, most of these nonanadromous populations occur above natural and man-made barriers. Historically, spawning by Upper Willamette River steelhead was concentrated in the North and Middle Santiam River Basins. These areas are now largely blocked to fish passage by dams, and steelhead spawning is distributed throughout more of the Upper Willamette River Basin than in the past. Due to introductions of non-native steelhead stocks and transplantation of native stocks within the basin, it is difficult to formulate a clear picture of the present distribution of native Upper Willamette River steelhead, and their relationship to nonanadromous and possibly residualized *O. mykiss* withing the basin.

Habitat loss, hatchery steelhead introgression, and harvest are major contributors to the decline the steelhead in this ESU. Details on factors contributing to the decline of west coast steelhead are discussed above.

iv. Lower Columbia River - Threatened

The following life history information is taken from EPA 2000 (50 CFR Parts 222 and 227 and 63FR32996).

This coastal steelhead ESU occupies tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon. Excluded are steelhead in the upper Willamette River Basin above Willamette Falls, and steelhead from the Little and Big White Salmon Rivers in Washington. The Lower Columbia River steelhead ESU was listed as threatened on March 19, 1998 (63FR13347). Official critical habitat was designated February 16, 2000. The lower Columbia River has extensive intertidal mud and sand flats and differs substantially from estuaries to the north and south. Rivers draining into the Columbia River have their headwaters in increasingly drier areas, moving from west to east. Columbia River tributaries that drain the Cascade mountains have proportionally higher flows in late summer and early fall than rivers on the Oregon coast.

Steelhead populations are at low abundance relative to historical levels, placing this ESU at risk due to random fluctuations in genetic and demographic parameters that are characteristic of small populations. There have been almost universal, and in many cases dramatic, declines in steelhead abundance since the mid-1980s in both winter- and summer-runs. Genetic mixing with hatchery stocks have greatly diluted the integrity of native steelhead in the ESU. NMFS is unable to identify any natural populations of steelhead in the ESU that could be considered "healthy".

Steelhead populations in this ESU are of the coastal genetic group (Schreck et al. 1986, Chapman et al. 1994, 50CFR Parts 222 and 227), and a number of genetic studies have shown that they are part of a different ancestral lineage than inland steelhead from the Columbia River Basin. Genetic data also show steelhead in this ESU to be distinct from steelhead in the upper Willamette River and coastal streams in Oregon and Washington. WDFW data show genetic affinity between the Kalama, Wind, and Washougal River steelhead. These data show differentiation between the Lower Columbia River ESU and the Southwest Washington and Middle Columbia River Basin ESUs. The Lower Columbia ESU is composed of winter steelhead and summer steelhead.

Habitat loss, hatchery steelhead introgression, and harvest are major contributors to the decline the steelhead in this ESU. Details on factors contributing to the decline of west coast steelhead are discussed above.

v. Middle Columbia River - Threatened

The following life history information is taken from EPA 2000 (63FR11797).

After a comprehensive status review of West Coast steelhead populations in Washington and Oregon, NMFS identified 15 ESUs. On March 10, 1998, the Middle Columbia River steelhead ESU was proposed as threatened (63FR11797). The middle Columbia area includes tributaries from above (and excluding) the Wind River in Washington and the Hood River in Oregon, upstream to, and including the Yakima River, in Washington. Steelhead of the Snake River Basin are excluded. Critical habitat was designated February 16, 2000.

Current population sizes are substantially lower than historic levels, especially in the rivers with the largest steelhead runs in the ESU, the John Day, Deschutes, and Yakima Rivers. At least two extinctions of native steelhead runs in the ESU have occurred (the Crooked and Metolius Rivers, both in the Deschutes River Basin). In addition, NMFS remains concerned about the widespread long- and short-term downward trends in population abundance throughout the ESU.

Genetic differences between inland and coastal steelhead are well established, although some uncertainty remains about the exact geographic boundaries of the two forms in the Columbia River (63FR11801). All steelhead in the Columbia River Basin upstream from The Dalles Dam are summer-run, inland steelhead. Life history information for steelhead of this ESU indicates that most middle Columbia River steelhead smolt at two years and spend one to two years in salt water (i.e., 1-ocean and 2-ocean fish, respectively) prior to re-entering freshwater, where they may remain up to a year before spawning. Within this ESU, the Klickitat River is unusual in that it produces both summer and winter steelhead, and the summer steelhead are dominated by 2-ocean steelhead, whereas most other rivers in this region produce about equal number of both 1- and 2-ocean steelhead.

The recent and dramatic increase in the percentage of hatchery fish in natural escapement in the Deschutes River Basin is a significant risk to natural steelhead in this ESU. Coincident with this increase in the percentage of strays has been a decline in the abundance of native steelhead in the Deschutes River.

e. Coho Salmon *(Oncorhynchus kisutch)*

The following life history information is from 60FR38011.

Listing as an endangered species for the Puget Sound/Strait of Georgia and the Lower Columbia River/Southwest Washington ESUs was determined by NMFS to be unwarranted in 1995.

Coho salmon are anadromous, meaning they migrate from the ocean to spawn in fresh water. The species was historically distributed throughout the North Pacific Ocean from central California to Point Hope, AK, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan. Historically, this species probably inhabited most coastal streams in Washington, Oregon, and central and northern California. Some populations, now considered extinct, are believed to have migrated hundreds of miles inland to spawn in tributaries of the upper Columbia River in Washington, and the Snake River in Idaho.

In contrast to the life history patterns of other anadromous salmonids, coho salmon in the region under status review generally exhibit a relatively simple, 3 year life cycle. Adults typically begin their freshwater spawning migration in the late summer and fall, spawn by mid-winter, then die. Run and spawn timing of adult coho salmon varies between and within coastal and Columbia River Basin populations... Depending on temperature, eggs incubate in ``redds'' (gravel nests excavated by spawning females) for 1.5 to 4 months before hatching as ``alevins'' (a larval life stage dependent on food stored in a yolk sac). Following yolk sac absorption, alevins emerge from the gravel as young juveniles or ``fry'' and begin actively feeding. Juveniles rear in fresh water for up to 15 months, then migrate to the ocean as ``smolts'' in the spring. Coho salmon typically spend two growing seasons in the ocean before returning to their natal stream to spawn as 3 year-olds. Some precocious males, called ``jacks,'' return to spawn after only 6 months at sea.

During this century, indigenous, naturally-reproducing populations of coho salmon are believed to have been extirpated in nearly all Columbia River tributaries and to be in decline in numerous coastal streams in Washington, Oregon, and California. At least 33 populations have been identified by agencies and conservation groups as being at moderate or high risk of extinction. In general, there is a geographic trend in the status of West Coast coho salmon stocks, with the southernmost and easternmost stocks in the worst condition.

i. Puget Sound/Strait of Georgia - Candidate

The Puget Sound/Strait of Georgia ESU received candidate status July 25, 1995 (60FR38011). Salmon in this ESU include all naturally spawned coho from the drainages of Puget Sound and Hood Canal, the eastern Olympic Peninsula, and the Strait of Georgia (from the eastern side of Vancouver Island and the British Columbia mainland, and excluding the upper Fraser River) (60FR38011). Coho salmon samples indicate that salmon in Puget Sound and the Strait of Georgia form a coherent genetic cluster (60FR38011).

According to NMFS, "Coho salmon within this ESU are abundant and, with some exceptions, run sizes and natural spawning escapements have been generally stable. However, artificial propagation of coho salmon appears to have had a substantial impact on native, natural coho salmon populations, to the point that it is difficult to identify self-sustaining, native stocks within this region. In addition, continuing loss of habitat, extremely high harvest rates, and a severe recent decline in average size of spawners indicate that there are substantial risks to whatever native production remains. There is concern that if present trends continue, this ESU is likely to become endangered in the foreseeable future. However, the size data examined are heavily influenced by fishery data from the Puget Sound. These fisheries target primarily hatchery stocks, and it is not known at this time to what extent the trends in size are influenced by hatchery fish. The extent of hatchery contribution to the natural spawning escapement and to natural production is unclear, as are the potential effects this contribution may have on the population genetics and ecology of this ESU. Further consideration of this ESU is warranted to attempt to clarify some of these uncertainties" (Weitkamp et al. 1995).

Please refer to the preceding general discussion of coho salmon for life history information and factors contributing to the decline of the species.

ii. Lower Columbia River/Southwest Washington - Candidate

The following life history summary is taken from EPA 2000 (NMFS 1996b and 60FR38011) and Weitkamp et al. 1995.

The Lower Columbia River/Southwest Washington ESU received candidate status July 25, 1995 (60FR38011). NMFS concludes that historically this ESU included coho salmon from all tributaries of the Columbia River below approximately the Klickitat and Deschutes Rivers, as well as coastal drainages in southwest Washington between the Columbia River and Point Grenville. The Columbia River estuary and Willapa Bay and Grays Harbor in southwest Washington all have extensive intertidal mud and sand flats and differ substantially from estuaries to the north and south.

At least one ESU of coho salmon probably occurred in the lower Columbia River Basin, but NMFS was unable to identify any remaining natural populations that warranted protection under the ESA. Coho salmon stocks above Bonneville Dam (except Hood River) are classified as extinct. The Clackamas River stock was classified as at moderate risk of extinction. While the number of naturally-reproducing fish within the LCSW coast ESU is fairly large, evaluating the risk to this ESU is difficult because of the uncertainty about the relationship of the present natural populations to the historic ESU. The LCSW coho salmon ESU is on the Candidate List until the distribution and status of the native populations can be resolved.

In addition, according to NMFS, "The BRT concluded that we cannot at present identify any remaining natural populations of coho salmon in the lower Columbia River (excluding the Clackamas River) or along the Washington coast south of Point Grenville that warrant protection under the ESA, although this conclusion would warrant reconsideration if new information becomes available. The Clackamas River produces moderate numbers of natural coho salmon. The Clackamas River late-run coho salmon population is relatively stable under present conditions, but depressed and vulnerable to overharvest. Its small geographic range and low abundance make it particularly vulnerable to environmental fluctuations and catastrophes, so this population may be at risk of extinction despite relatively stable spawning escapements in the recent past. As noted above, the BRT could not reach a definite conclusion regarding the relationship of Clackamas River late-run coho salmon to the historic lower Columbia River ESU. However, the BRT did conclude that if the Clackamas River late-run coho salmon is a native run that represents a remnant of a lower Columbia River ESU, the ESU is not presently in danger of extinction but is likely to become so in the foreseeable future if present conditions continue" (Weitkamp et al. 1995).

Please refer to the preceding general discussion of coho salmon for life history information and factors contributing to the decline of the species.

f. Sea-run Cutthroat Trout *(Oncorhynchus clarki clarki)*
The following life history information is from 64FR16397.

The life history of coastal cutthroat trout may be one of the most complex of any Pacific salmonid. Unlike other anadromous salmonids, sea-run forms of coastal cutthroat trout do not overwinter in the ocean and only rarely make extended migrations across large bodies of water. Their migrations in the marine environment are usually within 10 kilometers (6 miles) of land (Giger, 1972; Sumner, 1972; Jones, 1976; and Johnston, 1982), but have been detected up to 80 kilometers (50 miles) offshore (Pearcy, 1997). Although most anadromous cutthroat trout enter seawater as 2-or 3-year-old fish, some may remain in fresh water up to 5 years before entering the sea (Giger, 1972; and Sumner, 1972). Other cutthroat trout may not outmigrate to the ocean, but remain as nonmigrants in small headwater tributaries. Still other cutthroat trout may migrate entirely within freshwater environments (Nicholas, 1978; Tommasson, 1978; and Moring *et a*l., 1986), even when they have access to the ocean (Tomasson, 1978). In the Umpqua

River, anadromous, non-migratory, and freshwater migratory (river-migrating) life-history forms have been reported (Loomis and Anglin, 1992; and Loomis *et a*l., 1993). Details of coastal cutthroat trout life history and ecology, including characteristics of particular life-history forms, can be found in published reviews by Hall (1997), Bisson (1997), and Gresswell and Harding (1997). Unfortunately, these reviews indicate that the genetic and environmental factors determining these life-history forms are poorly understood, a situation that has complicated the characterization of ESU boundaries and risk for coastal cutthroat trout.

i. Southwest Washington/Columbia River - Proposed Threatened

The Southwest Washington/Columbia River ESU was listed as proposed threatened April 5, 1999 (64FR16397) and includes cutthroat trout in the Columbia River and its tributaries downstream from the Klickitat River in Washington and Fifteenmile Creek in Oregon (inclusive) and the Willamette River and its tributaries downstream from Willamette Falls (64FR16400). Cutthroat trout in Washington coastal drainages from the Columbia River to Grays Harbor (inclusive) are also included (64FR16400).

Habitat degradation in the Lowe Columbia River has contributed to dramatic declines in populations of anadromous cutthroat trout (Johnson et al. 1994). In addition, negative impacts from logging, which affects freshwater habitats, and dredging, filling, and diking of estuarine areas adversely affect the existence of this ESU (64FR16402). Other factors contributing to the decline of this ESU include: negative impacts from hatchery coastal cutthroat trout populations (Johnson et al. 1999); recreational fishing; hooking mortality and incidental catch in recreational and commercial fisheries targeting Pacific salmon and steelhead; and, hybridization with *O. mykiss;* (64FR16402-403).

For both anadromous adults and outmigrating smolts, trends are declining, with returns of naturally- and hatchery -produced cutthroat trout declining “markedly” over that past 10 to 15 years (Johnson et al. 1994). The NMFS biological review team was unanimous in concluding that this ESU was “likely to become endangered in the foreseeable future” (Johnson et al. 1999).

Please refer to the preceding general discussion of anadromous cutthroat trout for general life history information.

g. Bull Trout *(Salvelinus confluentus)*
The following life history information is taken from 63FR31648.

Bull trout (Salvelinus confluentus), members of the family Salmonidae, are char native to the Pacific northwest and western Canada. Bull trout historically occurred in major river drainages in the Pacific Northwest from about 41 deg. N to 60 deg. N latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in Northwest Territories, Canada (Cavender 1978; Bond 1992). To the west, bull trout range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992). Bull trout are wide-spread throughout tributaries of the Columbia River basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and the MacKenzie River system in Alberta and British Columbia (Cavender 1978; Brewin and Brewin 1997).

Bull trout and Dolly Varden (Salvelinus malma) were previously considered a single species (Cavender 1978; Bond 1992). Cavender (1978) presented morphometric (measurement), meristic (geometrical relation), osteological (bone structure), and distributional evidence to document specific distinctions between Dolly Varden and bull trout. Bull trout and Dolly Varden were formally recognized as separate species by the American Fisheries Society in 1980 (Robins et al. 1980). Although bull trout and Dolly Varden co-occur in several northwestern Washington river drainages, there is little evidence of introgression (Haas and McPhail 1991) and the two species appear to be maintaining distinct genomes (Leary et al. 1993; Williams et al. 1995; Kanda et al. 1997; Spruell and Allendorf 1997).

Bull trout exhibit resident and migratory life-history strategies through much of the current range (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear from one to four years before migrating to either a lake (adfluvial), river (fluvial), or in certain coastal areas, to saltwater (anadromous), where maturity is reached in one of the three habitats (Fraley and Shepard 1989; Goetz 1989). Resident and migratory forms may be found together and it is suspected that bull trout give rise to offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993).

Bull trout have more specific habitat requirements compared to other salmonids (Rieman and McIntyre 1993). Habitat components that appear to influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors (Oliver 1979; Pratt 1984, 1992; Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997).

Bull trout are found primarily in colder streams, although individual fish are found in larger river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman et al. in press). Water temperature above 15 deg. C (59 deg. F) is believed to limit bull trout distribution, which may partially explain the patchy distribution within a watershed (Fraley and Shepard 1989; Rieman and McIntyre 1995). Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992; Rieman and McIntyre 1993; Rieman et al. in press).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Oliver 1979; Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Pratt 1992; Thomas 1992;

Rich 1996; Sexauer and James 1997; Watson and Hillman 1997). Jakober (1995) observed bull trout overwintering in deep beaver ponds or pools containing large woody debris in the Bitterroot River drainage, Montana, and suggested that suitable winter habitat may be more restrictive than summer habitat. Maintaining bull trout habitat requires stream channel and flow stability (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period and channel instability may decrease survival of eggs and young juveniles in the gravel during winter through spring (Fraley and Shepard 1989; Pratt 1992; Pratt and Huston 1993).

Preferred spawning habitat consists of low gradient streams with loose, clean gravel (Fraley and Shepard 1989) and water temperatures of 5 to 9 deg. C (41 to 48 deg. F) in late summer to early fall (Goetz 1989). Pratt (1992) indicated that increases in fine sediments reduce egg survival and emergence. High juvenile densities were observed in Swan River, Montana, and tributaries with diverse cobble substrate and low percentage of fine sediments (Shepard et al. 1984). Juvenile bull trout in four streams in central Washington occupied slow-moving water less than 0.5 m/sec (1.6 ft/sec) over a variety of sand to boulder size substrates (Sexauer and James 1997).

Bull trout typically spawn from August to November during periods of decreasing water temperatures. However, migratory bull trout frequently begin spawning migrations as early as April, and have been known to move upstream as far as 250 kilometers (km) (155 miles (mi)) to spawning grounds (Fraley and Shepard 1989). Bull trout require spawning substrate consisting of loose, clean gravel relatively free of fine sediments (Fraley and Shepard 1989). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992), and after hatching, juveniles remain in the substrate. Time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May depending upon water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992).

Growth varies depending upon life-history strategy. Resident adults range from 150 to 300 millimeters (mm) (6 to 12 inches (in)) total length and migratory adults commonly reach 600 mm (24 in) or more (Pratt 1985; Goetz 1989). The largest verified bull trout is a 14.6 kilogram (kg) (32 pound) specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Bull trout are opportunistic feeders with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton and small fish (Boag 1987; Goetz 1989; Donald and Alger 1993). Adult migratory bull trout are primarily piscivorous, known to feed on various fish species (Fraley and Shepard 1989; Donald and Alger 1993).

Bull trout habitat in the coterminous United States is composed of a complex mosaic of land ownership, including Federal lands administered by the U.S. Forest Service (USFS), U.S. Bureau of Land Management (BLM), U.S. National Park Service (NPS), and Department of Defense (DOD); numerous Indian tribal lands; state land in Montana, Idaho, Oregon, Washington and Nevada; and private lands. It is estimated that as much as half of present bull trout habitat is bordered by non-Federal lands.

Though wide-ranging in parts of Oregon, Washington, Idaho and Montana, bull trout in the interior Columbia River basin presently occur in only about 44 to 45 percent of the historical range (Quigley and Arbelbide 1997; Rieman et al. in press). Declining trends and associated habitat loss and fragmentation have been documented rangewide (Bond 1992; Schill 1992; Thomas 1992; Ziller 1992; Rieman and McIntyre 1993; Newton and Pribyl 1994; Idaho Department of Fish and Game (IDFG), in litt. 1995; McPhail and Baxter 1996). Several local extirpations have been reported, beginning in the 1950s (Rode 1990; Ratliff and Howell 1992; Donald and Alger 1993; Goetz 1994; Newton and Pribyl 1994; Berg and Priest 1995; Light et al. 1996; Buchanan et al. 1997; WDFW 1997). For example, bull trout were apparently extirpated around 1975 from the McCloud River, California, the southernmost range (Moyle 1976; Rode 1990).

i. Coastal/Puget Sound - Threatened

The Coastal-Puget Sound bull trout "Distinct Population Segment (DPS)" was listed as threatened November 1, 1999 (64FR58909) and encompasses all Pacific coast drainages within the coterminous United States north of the Columbia River in Washington. The Coastal-Puget Sound population segment is geographically segregated from other subpopulations by the Pacific Ocean and the crest of the Cascade Mountain Range, and this segment is significant to the species as a whole because it is thought to contain the only anadromous forms of bull trout in the coterminous United States (63FR31695). As an anadramous species, it may spend a portion of its life in saltwater.

Within their range, bull trout are sympatric with Dolly Varden (63FR31696). The WDFW currently manages both species together as native char, as the two species are nearly impossible to visually differentiate. The Coastal-Puget Sound population segment contain 35 subpopulations of "native char" (bull trout, Dolly Varden, or both species) and 15 of these have been differentiated by both genetic and morphological-meristic analyses (63FR31696). Bull trout were confirmed in 12 of 15 subpopulations investigated (5 with only bull trout, 3 with only Dolly Varden, and 7 with both species), and it is likely that bull trout occur in the majority of the remaining 20 subpopulations (63FR31696).

As discussed below, for the Columbia River DPS, land and water management activities that degrade and continue to threaten all of the bull trout distinct population segments in the coterminous United States include dams, forest management practices, livestock grazing, agriculture and agricultural diversions, mining, residential development, road building, introduced non-native species, overharvest, fragmentation and isolation of bull trout subpopulations from habitat changes caused by human activities, and subpopulation extirpations due to naturally occurring events such as droughts, floods and other environmental events (63FR31700). In addition, the persistence of native char populations in the Coastal-Puget Sound DPS is threatened by competition and hybridization with introduced brook trout (63FR31706).

Bull trout and native char in the Coastal-Puget Sound DPS, despite their relative widespread distribution, have declined in abundance and distribution within many individual river basins (63FR31707). Bull trout and native char currently occur as 35 isolated subpopulations, which indicates the high level of habitat fragmentation and geographic isolation (63FR31707). Eight subpopulations are isolated by dams or other diversion structures, with at least 17 dams proposed in streams inhabited by other bull trout or ``native char'' subpopulations (63FR31707).

ii. Columbia River - Threatened
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The Columbia River bull trout was listed as threatened on June 10, 1998. This DPS occurs throughout the entire Columbia River basin within the United States and its tributaries, excluding bull trout found in the Jarbidge River, Nevada (63FR31650).

A number of threats to this DPS exist. Bull trout passage is prevented or inhibited at hydroelectric, flood-control, or irrigation dams in almost every major river in the Columbia River basin except the Salmon River in Idaho (63FR31657). In addition, dams can result in the loss of individuals from a subpopulation which is divided by a dam.

Forestry activities that adversely affect bull trout and its habitat are primarily timber extraction and road construction, especially when impacting riparian areas. These activities, when conducted without adequate protective measures, alter bull trout habitat by increasing sedimentation, reducing habitat complexity, increasing water temperature, and promoting channel instability. Although certain forestry practices have been prohibited or altered in recent years to improve protection of aquatic habitats, the consequences of past activities continue to affect bull trout and their habitat. Within the Columbia River population segment, approximately 74 percent of bull trout subpopulations are threatened by forestry management practices.

Livestock grazing and agricultural practices also negatively impact Columbia River bull trout. Livestock grazing degrades aquatic habitat by removing riparian vegetation, destabilizing streambanks, widening stream channels, promoting incised channels and lowering water tables, reducing pool frequency, increasing soil erosion, and altering water quality (63FR31660). Agriculture degrades habitat through nonpoint source pollution and irrigation practices which lower stream flow and use unscreened irrigation diversions which can trap and strand bull trout in ditches and agricultural fields (63FR31660). Mining, residential development, road building, introduced non-native species, overharvest, fragmentation and isolation of bull trout subpopulations from habitat changes caused by human activities, and subpopulation extirpations due to naturally occurring events such as droughts, floods and other environmental events also have contributed to the decline of this DPS (63FR31660, 63FR31700).

Based on abundance, trends in abundance, and the presence of life-history forms, bull trout were considered strong (i.e., 5,000 individuals or 500 spawners likely occur in the subwatershed or larger area, abundance is stable or increasing with at a minimum of half of historic abundance, and the presence of all life-history forms historically present) in 13 percent of the occupied range in the interior Columbia River basin (63FR31651). Using various estimates of bull trout range, it is estimated that bull trout are strong in 6 to 24 percent of the subwatersheds in the Columbia River basin ((63FR31651).

h. Dolly Varden - Proposed

Dolly Varden was proposed to be listed January 9, 2001. In Washington, the Dolly Varden, an anadromous char and a member of the family Salmonidae, occurs in several river drainages within the Coastal-Puget Sound distinct population segment of the bull trout (Salvelinus confluentus) (66FR1629). Due to the close similarity in appearance of bull trout and Dolly Varden, law enforcement personnel have substantial difficulty in differentiating between the two species and the determination of threatened status due to similarity of appearance for Dolly Varden will extend to this species the prohibitions against take that apply to bull trout, and will substantially facilitate law enforcement actions to protect bull trout (66FR1629). As an anadramous species, the Dolly Varden may spend a portion of its life in saltwater.

Dolly Varden adults can reach 2 to 5 pounds, and the record Dolly Varden, taken from the Skykomish River, weighed 10 pounds (WDFW 1997). When compared to bull trout, Dolly Varden tend to have a more rounded body shape while bull trout have a larger, more flattened head and a more pronounced hook on the lower jaw (WDFW 1997). Their color varies with habitat and locality, but the body is usually olive green, with the back being darker than the pale sides (WDFW 1997). Cream to pale yellow spots (slightly smaller than the pupil of the eye) cover the back, and red or orange spots cover the sides, and the pectoral, pelvic and anal fins have white or cream-colored margins (WDFW 1997). During fall spawning the male has a dark olive back, an orange-red belly, bright red spots, and fluorescent white fin edges (WDFW 1997). Sea-run Dolly Varden are silver with very faint spots (WDFW 1997).

Dolly Varden were historically found throughout the Pacific Northwest, from Northern California to the upper Yukon and Mackenzie drainages in Canada (WDFW 1997). They are found throughout Washington except in the area east of the Columbia River and north of the Snake River (WDFW 1997). The geographic ranges of bull trout and Dolly Varden overlap only in the range of the Coastal/Puget Sound DPS (Western Washington and the Olympic Peninsula) (66FR1630).

Bull trout and Dolly Varden have similar life histories (WDFW 1997). In addition, threats to Dolly Varden are similar to those for bull trout, as discussed above, and include habitat loss and degradation, overharvest, and competition from and hybridization with the eastern brook trout (WDFW 1997).

2. BIRDS

a. Bald Eagle *(Haliaeetus leucocephalus)* - Threatened

The bald eagle is the only sea eagle regularly occurring on the North American continent (60FR36000). Its range extends from central Alaska and Canada to northern Mexico (60FR36000). As a bird of aquatic ecosystems, the bald eagle's habitat includes estuaries, lakes, reservoirs, rivers, and some seacoast areas (60FR36000).

The bald eagles' breeding range extends from the Alaskan coast down through western Canada (with the exception of southern regions of Alberta and Saskatchewan), eastward through southern Canada and the Great Lakes, then northward to the eastern Canadian coast (60FR36000). In the winter, bald eagles can be found throughout much of the United States west of the Mississippi, especially along the coast from southern Alaska and western Canada to Washington and along the upper Mississippi (WSDOT 2001i). In Washington, bald eagles nest along the Pacific Ocean, Puget Sound, large lakes, and major rivers and winter along rivers which support large runs of anadromous fish, the Pacific Ocean, and along Puget Sound (WSDOT 2001i).

Though bald eagles populations in the US are currently increasing in many areas, the decline in the species over the past 200 years has been severe. When Europeans first arrived on the North American continent, there were an estimated one-quarter to one-half million bald eagles (60FR36000). The first major decline in the bald eagle population probably began in the mid to late 1800's and coincided with declines in numbers of waterfowl and shorebirds and other major prey species (60FR36000). Killing of eagles and loss of nesting habitat contributed to their decline (60FR36000). The Bald Eagle Protection Act of 1940 resulted in a partial recovery or a slower decline of the species in most areas of the country, but persecution continued (60FR36000). After World War II, use of organochlorine compounds such as DDT further reduced the US population of bald eagles by interfering with their reproduction.

In 1978, the bald eagle was listed as endangered under the ESA in the lower 48 states, except for Michigan, Minnesota, Wisconsin, Washington, and Oregon where it was designated as threatened (60FR36000). Improvement in the species numbers is a result of the banning of DDT and other persistent organochlorines, habitat protection, and other recovery efforts (60FR36000).

In Washington, the early summer population of bald eagles when white settlers first arrived may have been around 6,500 (Stinson et al. 2001). Persecution, the cutting of forests, commercial exploitation of salmon runs, and the use of DDT reduced the state's population to 105 known breeding pairs by 1980 (Stinson et al. 2001). Loss of wetlands, contamination of estuaries, and declines in water quality have also likely reduced the carrying capacity for eagles (Stinson et al. 2001). The Washington population has recovered greatly since the ban on DDT in 1972, with a 10% per year growth rate; in 1998, there were 664 occupied nests and the predicted wintering bald eagle population for 2000 was 4500 (Stinson et al. 2001). The USFWS is expected to remove the bald eagle from the federal list of threatened and endangered species in 2001, though they will still be protected by the Bald and Golden Eagle Protection Act and the

Migratory Bird Treaty Act (Stinson et al. 2001). Current threats to the bald eagle Washington include: insecure nesting areas (with two-thirds of nests on private lands); development of land near shores; and logging (Stinson et al. 2001).

b. Marbled murrelet *(Brachyramphus marmoratus marmoratus)* - Threatened

The marbled murrelet is a robin-sized sea bird of the family Alcidae (Marshall 1988). Historically, marbled murrelets were found in many of the coastal regions of Washington. Currently, marbled murrelets are found during the breeding season along the northern part of the outer coast of Washington and in the Puget Sound, including the Straits of Georgia and Juan de Fuca and the San Juan Islands (Pacific Biodiversity Institute 2002). The southern coast of Washington also provides nesting habitat (Pacific Biodiversity Institute 2002). Known areas of winter concentration include portions of the Strait of Georgia, the southern and eastern end of the Strait of Juan de Fuca, San Juan Island, and Puget Sound (Nelson 1997).

In the US, the marbled murrelet nests in mature and old-growth coastal forests and sea-facing talus slopes or cliffs along the west coast, from the Aleutian Islands of Alaska to central California (Nelson 1997). The marbled murrelet can usually be found within 5 km of shore in the continental US and within 50 km of the shore in Alaska (Nelson 1997). A solitary species, information is limited on its nesting habits, behavior, habitat associations and population numbers (Nelson 1997).

The marbled murrelet is an opportunistic feeder. During the summer, the marbled murrelet forages primarily in bays, inlets, fjords, and the open ocean and have been know to forage in freshwater lakes in Washington (Nelson 1997). During breeding season, adults and chicks consume small schooling fish, including the Pacific sand lance, the northern anchovy and the Pacific herring (Nelson 1997). In the winter and spring, murrelets consume primarily Euphausiids, gammarid amphipods, capelin, smelt, and herring (Nelson 1997).

The marbled murrelet spends much of its time at sea, swimming or resting on the ocean surface (Nelson 1997). There is little information on the murrelet's underwater foraging behavior, but evidence indicates that the murrelet dives beneath the sea surface and pursues prey underwater (Nelson 1997). Dives are short in duration (20-44 seconds) and murrelets usually forage within 50 meters of the surface (Nelson 1997).

Nelson (1997) estimates that the total population of murrelets in North America is between 263,000 and 841,000 and in Washington 5,000 to 6,500. According to the USFWS, a 1987 study reported between 4,400 and 8,300 individuals, or 1,900 – 3,500 breeding pairs (Marshall 1988). According to population projections from the USFWS 1997 recovery plan, marbled murrelet numbers are declining at a rate of at least 4 to 7 percent per year (Pacific Biodiversity Institute 2002).

The decline in the marbled murrelet population is largely due to logging and development of its habitat (Nelson 1997). The murrelet is facing decreasing habitat throughout most of its range; large populations remain in Alaska and British Columbia, where substantial old-growth forest remains, but continued logging and development can be expected to cause a further decline in marbled murrelet populations there (Marshall 1988). Gill net fishing and oil spills also are responsible for murrelet mortality, and that of its prey species (Nelson 1997). The low reproductive rates of the marbled murrelet compound these problems.

c. Short-tailed Albatross *(Phoebastria albatrus)* - Endangered

The following is taken from EPA 2001.

The short-tailed albatross once ranged throughout most of the North Pacific Ocean and Bering Sea. Breeding colonies of the short-tailed albatross are currently known on two islands in the western North Pacificand East China Sea. Torishima Island, the main nesting island, is controlled by Japan and is protected as a National Monument. Ownership of the second island, Minami-Kojima, is disputed. This island is claimed by Japan and China (by both the Republic of China located on Taiwan and by the People's Republic of China). Due to an error, the Fish and Wildlife Service mistakenly designated this species as endangered throughout their range except in the U.S. In November, 1998, the Service announced a proposed rule to include the U.S. in the protected range of this species. These birds mate for life, returning to the same nest sites in the breeding colony for many years. Short-tailed albatross nesting occurs on flat or sloped sites, with sparse or full vegetation, on isolated windwept offshore islands. Five months after hatching, chicks leave the nest to wander across the North Pacific. Adults spend their non-breeding seasons at sea as well, feeding on squid, fish, flying fish eggs, shrimp and other crustaceans (ADFG 1997).

During the late 1800s and early 1900s, feather hunters killed an estimated 5 million short-tailed albatrosses. In the 1930s, volcanic eruptions damaged the nesting habitat on the last nesting island in Japan. However, by this time, protection measures were already in place in Asia and the animals have begun to recover (ADFG 1997). Only one primary breeding colony exists on Torishima Island in Taiwan. Because of the significance of this breeding colony, the threat of habitat destruction by volcanic eruptions poses the most severe danger to the existence of the species. Other factors may also hinder the recovery of the short-tailed albatross including damage or injury related to oil contamination, consumption of plastic debris in marine waters, and accidental entanglement in fishing gear, especially baited longline hooks. Natural environmental threats, small population size, and the small number of breeding colonies continue to put the worldwide population of short-tailed albatrosses in danger of extinction. Other threats such as pollution or entanglement with fishing gear do not represent significant threats, but, in combination with a catastrophic event, could threaten the future survival of this species (50FR58692).

d. Brown Pelican *(Pelecanus occidentalis)* - Endangered

The brown pelican breeds in large colonies on the Channel Islands in Southern California, along the Baja peninsula, and in the Gulf of California, Mexico (Pacific Biodiversity Institute

2002c). During the summer and fall, birds migrate northward from their breeding grounds and can be seen near the Oregon and Washington coast (Pacific Biodiversity Institute 2002c).

Brown pelicans feed primarily in shallow estuarine waters, consuming up to four pounds of fish, the staple of their diet, per day (WSDOT 2002). Their diet includes pigfish, pinfish, herring, sheepshead, silversides, mullet, grass, top minnows, and crustaceans (WSDOT 2002). When diving for prey, they may submerge partially or completely. Their keen eyesight allows them to spot fish from heights of 60 to 70 feet (WSDOT 2002). The brown pelican feeds primarily in shallow estuarine waters, and they rarely venture more than 20 to 40 miles out to sea (WSDOT 2002). The brown pelican uses sand spits and offshore sand bars for daily loafing and nocturnal roosting areas; their preferred nesting sites are small coastal islands which provide protection from mammal predators and are of sufficient elevation to prevent flooding of their nests (WSDOT 2002).

The brown pelicans preference for island nesting sites made them easy prey for egg hunters who raided the rookeries by boat (Pacific Biodiversity Institute 2002c). In the 19th and early 20th centuries, brown pelicans were killed for their feathers and because they were perceived as a threat to commercial fisheries (Pacific Biodiversity Institute 2002c). However, ingestion of pesticide residues in fish was the largest cause of their decline. Chlorinated hydrocarbons and polychlorinated biphenyls, including DDT, resulted in thin-shelled eggs that were crushed by incubating adults. The ban on DDT, and the decline in use of some pesticides, such as endrin, has helped the species to recover though other threats exist: human disturbance of nesting colonies, mortalities from birds being caught on fish hooks and entangled in monofilament line, oil or chemical spills, erosion, plant succession, storms, and unpredictable food availability (WSDOT 2002).

e. Western Snowy Plover *(Charadrius alexandrinus nivosus)* - Threatened

A subpopulation of the snowy plover, the western snowy plover is a sand-colored shore bird that nests along the coast from Baja California north to southern Washington (Pacific Biodiversity Institute 2002b). Washington populations are migratory and head further south during the winter months (Pacific Biodiversity Institute 2002b). According to WDFW estimates, only two nesting areas remain in Washington, both on the southern coast and containing less than 10 nests per year (Pacific Biodiversity Institute 2002b, WDFW 1998).

The snowy plover species contains up to 3 subspecies in the Americas, including the western snowy plover. The snowy plover's preferred nesting habitat in Washington is barren coastal dunes (WDFW 1998). On the Pacific coast, the snowy plover nests on barren to sparsely vegetated sand beachs, dry salt flats in lagoons, dredge spoils deposited on beach or dune habitat, and river bars (Page 1995). Its primary food source is terrestrial and aquatic invertebrates, including mole crabs, crabs, polychaetes, amphipods, flies, beetles, clams, and ostracods (Page 1995). On the coast, snowy plovers feed on beaches, tide flats, salt flats, and salt ponds and inland at lakes, reservoirs, ponds, braided river channels, and playas (Page 1995).

Only 21,000 snowy plover (including western snowy plover) individuals inhabit the United

States, with 4,000 nesting on the Pacific coast (Page 1995). According to Page (1995), in California, Oregon, Washington, and Nevada combined there was an approximately 20% decline in the breeding population between the late 1970s and late 1980s.

The western snowy plover population is declining largely due to habitat degradation and expanding use of beaches for recreation. On the coast of California, nests are destroyed by being trampled by people on foot, on horse, or in vehicles, and dogs also cause plover mortality (Page 1995). In addition, according to the WDFW (1998), in Washington "beach grasses planted to stabilize dune systems have encroached on the open areas required by nesting snowy plovers." However, critical habitat has been designated for the snowy plover. In December 1999, the federal government set aside 18,000 acres of nesting habitat along the Pacific coast, an area encompasses 180 miles, or about 10%, of the coastline in Washington, Oregon and California (Pacific Biodiversity Institute 2002b).

3. WHALES

a. Humpback Whale *(Megaptera novaeangliae)* - Endangered

Humpback whales belong to the rorqual, or Balaenopteridae, family of the baleen whales in the suborder Mysticeti. One of the most distinguishing characteristics of humpback whales is their long flippers, approximately one third their body length (EPA 2001). Surveys indicate that humpbacks occupy habitats around the world, with three major distinct populations: the north Atlantic, the north Pacific, and the southern oceans. These three populations do not interbreed. Humpbacks generally feed for 6-9 months of the year on their feeding grounds in Arctic and Antarctic waters. The animals then fast and live off their fat layer for the winter period while on the tropical breeding grounds (CRU 1998).

Within the US Exclusive Economic Zone (EEZ), NMFS has found at least three relatively separate populations of humpback whales in the North Pacific that migrate within their respective summer/fall feeding areas and winter/spring calving and mating areas: the California/Oregon/Washington - Mexico stock; the Central North Pacific stock; and the Western North Pacific stock (NMFS 2000f). The population which migrate through Washington are part of the California/Oregon/Washington - Mexico stock: winter/spring populations in coastal Central America and Mexico which migrate to the coast of California to southern British Columbia in summer/fall (NMFS 2000f).

The herd of humpback whales that typically occupies southeastern Alaska waters also migrates to Hawaii and Mexico in the winter months for breeding. This herd does appear to remain geographically separated from the other Alaskan herds in Prince William sound and on the western Gulf of Alaska coastline (Small and DeMaster 1995). The Southeast Alaskan herd makes up approximately 17-25% of the North Pacific population and generally occupies this area from summer to fall (Perry and Baker 1986). The rest of the Alaskan humpback whale population occupies areas from Japan to the Kodiak Archipelago, including the Bering Sea and

Aleutian Islands (Small and DeMaster 1995). Humpbacks eat primarily small schooling fish such as herring, capelin, pollock, and sandlance. They also commonly consume euphausiid shrimp (Perry and Baker, 1986; Baker 1985).

Whaling was responsible for a decline in the humpback population from the late 1800s through the early 20th century. Current estimates give the population size of the north Pacific stock at 4,000 animals. Prior to 1905, the population of humpback whales in the North Pacific was estimated to be 15,000, which was reduced by whaling to approximately 1,200 in 1966 (NMFS 2000f). The International Whaling Commission (IWC) prohibited the taking of humpback whales in the early 1960's and, as a result of this protection and the efforts of individual countries, the species continues to recover. Currently, the North Pacific stock exceeds 6,000 humpback whales (NMFS 2000f). The minimum population estimate for humpback whales in the California/Oregon/Washington - Mexico stock in 1997-1998 was 861, and the stock appears to be growing (NMFS 2000f). The largest threats to their survival include entanglements in fishing gear, collisions with ship traffic, and pollution of their coastal habitat from human settlements (CRU 1998). Humpback whales breed and feed near the coast, and are thus more vulnerable to these threats.

b. Blue Whale *(Balaenoptera musculus)* - Endangered

The following is taken from EPA 2001.

Blue whales inhabit every ocean of the world, from the equator to the poles. The largest animal that ever lived, this endangered species migrates annually to polar waters to feed in the summer, then returns to temperate and tropical waters for winter breeding. However, observers have rarely spotted this pelagic species near the coast, except in polar regions. Near the poles, blue whales frequently follow the retreating ice-edge as summer progresses. Blue whales faithfully return to feeding areas, but we know little about the breeding grounds of this animal. These animals appear to practice more selective behavior in feeding than other rorquals (those baleen whales that posses external throat grooves that expand during gulp-feeding) and specialize in plankton feeding, particularly swarming euphausiids in the Antarctic. They will preferentially take euphausiids even with abundant shoaling fish in the area. Copepods and decapods make up a small and rarely observed portion of the blue whale’s diet (Harrison and Bryden 1988).

The introduction of steam power in the second half of the 19th century allowed boats to overtake the large, fast-swimming blue whales, but not until the development of the deck-mounted harpoon cannons did killing and securing of blue whales occur on an industrial scale. Blue whales gained protection under the International Convention for the Regulation of Whaling in 1966, however, Russian whalers continued to take whales illegally in both the northern and southern Pacific. Whaling has caused the largest reductions in the population of this species, but other factors may also contribute to its decline or may prevent the population’s recovery. These factors include collisions with ships, disturbance from vessels, both commercial and recreational, entanglement in fishing gear, habitat degradation, and aquatic pollution. Little evidence exists to support the conclusion that any of these factors caused a serious decline in the blue whale population, however, but these factors may prevent the recovery of the species (Reeves et al. 1998a).

NMFS (2000g) states that the best estimate of blue whale abundance off the coast of California, Oregon, and Washington is 1,940. Growth in abundance of this species in California coastal waters in uncertain (NMFS 2000g). Though the population in the North Pacific can be expected to have grown since being given protected status in 1966, the possibility of unauthorized takes and the occurrence of incidental ship strikes and gillnet mortality, coupled with unclear data regarding growth in abundance, makes this uncertain (NMFS 2000g).

c. Fin Whale *(Balaenoptera physalus)* - Endangered
The following is taken from EPA 2001.

Fin whales are baleen whales found in offshore waters throughout the north Pacific from Baja California to the Chukchi Sea. High concentrations of these endangered animals inhabit the northern Gulf of Alaska and southeastern Bering Sea in the summer (Reeves et al. 1998b). Observers have rarely reported sightings of this pelagic species in inshore coastal waters (Harrison and Bryden 1988). With a complex migratory behavior, these whales can occur in any season at many different latitudes (Harrison and Bryden 1988). Even though they may easily enter polar waters, these whales are not commonly observed close to the polar pack ice, unlike blue whales (Harrison and Bryden 1988). Their movements may depend on the whale's age or reproductive status as well as the stock to which it belongs. The National Marine Fisheries Service recognizes three Pacific stocks in U. S. waters: Alaska, California/Washington/Oregon, and Hawaii. We do not know where fin whales breed, but research indicates that they are primarily solitary animals. They may coordinate in groups of up to 15 infrequently. However, the low frequency vocalizations made by whales can travel some distance, making it difficult to determine which whales associate with one another (CRU 1998). In the north Pacific, fin whales prefer euphausiid shrimp and large copepods as prey, but also consume schooling fish such as herring, walleye, pollock, and capelin (Reeves et al 1998b). Current information indicates that these whales feed seasonally (Harrison and Bryden 1988).

After the commercial extinction of the blue whale, whalers turned their attention to fin whales. Whalers took almost 500,000 whales between the 1930s and 1960s, mostly in the Antarctic. Now that this species enjoys worldwide protection from whaling, scientists estimate the number of fin whales to total to 60,000-100,000 animals. Currently, the largest threats to fin whales include development and habitat destruction, entanglement with fishing gear, and a renewed interest in whaling by several countries (CRU 1998). In addition, NMFS states, "the increasing levels of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales, particularly for baleen whales that may communicate using low-frequency sound" (NMFS 2000h).

Based on ship surveys, 1,236 fin whales are estimated to be off the coast of Washington, Oregon, and California (NMFS 2000h). There are no estimates for the growth in this population (NMFS 2000h).

d. Sei Whale *(Balaenoptera borealis)* - Endangered

" \l 3 The following is taken from EPA 2001.

In the north Pacific, the endangered sei whale occurs mainly south of the Aleutian Islands. Some reports document sightings by Japanese scientists, indicating that sei whales may occur in the northern and western Bering Sea, but these data have not been confirmed and must be considered suspect. Sei whales do occur all across the temperate north Pacific north of 40☜N. Their southern range extends as far south as Baja California, Mexico, in the eastern Pacific, and to Japan and Korea in the west (Reeves et al. 1998b). Only the largest adults venture into true polar waters (Harrison and Bryden, 1988). This pelagic species generally does not inhabit inshore and coastal waters. Sei whales mainly feed on copepods and euphausiids; however, whales in the north Pacific also prey on pelagic squid and fish up to the size of an adult mackerel (Reeves et al. 1998b). Essentially, the species will take any swarming or shoaling prey species in abundance locally.

Of any threat to this species, whaling has claimed the largest proportion of sei whales. Whalers took several hundred sei whales each year from shore stations in Japan and Korea between 1910 and the start of World War II. Heavy exploitation by pelagic whalers began in the early 1960s. The reported take of sei whales in the north Pacific by commercial whalers totaled 61,500 for the years between 1947-1987. Other threats currently may affect sei whales, but do not result in significant takes compared to the decimation caused by whaling. These threats may include collisions with ships, disturbance from vessels, entanglement with fishing gear, and aquatic pollution (Reeves et al. 1998b).

NMFS states that only one confirmed sighting of sei whales and 5 possible sightings (identified as sei or Bryde 's whales) were made in California waters during extensive ship and aerial surveys in 1991, 1992, 1993, and 1996, and NMFS did not report any sightings of sei whales in aerial surveys of Oregon and Washington (NMFS 2000i). There are no abundance estimates for sei whales in the eastern North Pacific or along the west coast of the U.S. (NMFS 2000i).

e. Sperm Whale *(Physeter macrocephalus)* - Endangered

The following is taken from EPA 2001.

The largest of all the toothed whales, sperm whales occur in all the world’s oceans, from the equator to polar waters. They rarely enter semi-enclosed areas, but instead prefer oceanic habitat (Harrison and Bryden 1988). The distribution of sperm whales depends on their food source, suitable conditions for breeding, and the sex and age composition of the group (NMFS 1984). Males generally tolerate a wider range of temperatures and migrate into the higher latitudes, while females and juveniles remain in warm oceanic waters all year round. These whales also tend to inhabit waters at 600 or more feet in depth, and only rarely occur in waters less than 300 feet deep. Calving generally occurs in the summer and fall (Harrison and Bryden

1988).

Sperm whales feed almost exclusively on cephalopods (squid and octopi), but in a few places, such as Alaska, fish form an important part of the diet. Some of the fish species consumed include rays, sharks, lanternfish, cod, and redfish. Feeding occurs all year, usually at depths below 400 feet (Harrison and Bryden 1988).

Commercial whaling did exploit the sperm whale to a large extent; however, the population of sperm whales still numbers almost two million animals, about half of which inhabit the North Pacific(NMFS 1984; Harrison and Bryden 1988). Entanglement with fishing gear, especially drift gill nets has recently become a more significant problem. Aquatic pollution may also impact these animals, but evidence is scarce to support this conclusion (NMFS 1984).

In Oregon and Washington, sperm whales are seen all year except for winter (NMFS 2000j). NMFS cites an estimate of 1,191 sperm whales along the coasts of California, Oregon, and Washington during summer/fall based on ship line transect surveys in 1991, 1993, and 1996; an estimated 24,000 sperm whales inhabit the entire eastern North Pacific region (NMFS 2000j). Sperm whales are the third most abundant whale in this area, after gray and humpback whales (NMFS 2000j). NMFS (2000j) states, “Although the population in the eastern North Pacific is expected to have grown since large-scale pelagic whaling stopped in 1980, the possible effects of large unreported catches are unknown and the ongoing incidental ship strikes and gillnet mortality make this uncertain.”

4. STELLER SEA LIONS *(Eumetopias jubatus)* - Threatened

The following is taken from EPA 2001.

The largest of the otariids, Steller sea lions belong to the Suborder Pinnipedia and Family Otariidae. They show a marked sexual dimorphism, with adult males larger than adult females. Steller sea lions are polygamous and use traditional territorial sites for breeding and resting. Breeding sites, also known as rookeries, occur on both sides of the north Pacific, but the Gulf of Alaska and Aleutian Islands contain most of the large rookeries. Adults congregate for purposes other than breeding in areas known as haulouts (NMFS 1996d). In 1997, NMFS classified Steller sea lions into two distinct population segments divided by the 144☜W latitude. The eastern population segment occupies habitat including southeastern Alaska [and Washington]. Currently, NMFS has classified the western population segment as endangered, while classifying the eastern population segment as threatened (62FR24345). Although the Steller sea lion population has declined steadily for the last 30 years, scientists have yet to identify the cause of the decline (NMFS 1992).

Steller sea lions spend most of their time at rookeries or haulouts; this is also where most scientific observations are made. Habitat types that typically serve as rookeries or haulouts include rock shelves, ledges, and slopes and boulder, cobble, gravel, and sand beaches. When foraging in marine habitats, Steller sea lions typically occupy surface and midwater ranges in coastal regions (Hoover 1988). Some animals may also follow prey into river and inlet systems

(T. Loughlin, NMFS, personal communication, 29 July 1998).

Pollock and mackerel comprise most of the diet of Steller sea lions. They also frequently consume other small schooling fish such as salmon, herring, and capelin (NMFS 1992; Merrick et al. 1997). The sea lions generally leave haulouts and rookeries to feed for periods of time varying from hours to months. However, they often return to the same haulout or rookery even after lengthy absences (NMFS 1992).

Threats to Steller sea lions include environmental changes, incidental take, commercial harvest of prey species, and disturbances associated with tourism and industry. Environmental changes may affect food supply, thus affecting survival and productivity. Incidental take has not generally affected the species since the mid-1980's. Commercial harvest of prey species, such as pollock, may affect the survival and health of the species, but limitations of data and models make it difficult to determine the effects of this practice. Tourism and industry bring with them a host of activities that may affect the sea lions through vessel traffic and the potential for chemical spills. Studies have not determined the potential effects of pollutants, but evidence does not indicate an immediate threat from toxic pollutants under current conditions (NMFS 1996a).

During the summer of 1996, NMFS conducted aerial surveys and ground counts of California, Oregon, and Washington rookeries and major haulout sites, finding a total of 6,555 Steller sea lions in California (2,042), Oregon (3,990), and Washington (523), including 5,464 nonpups and 1,091 pups (NMFS 2000k). The cumulative total for Steller sea lions in the eastern stock is 30,403, which NMFS reasons is an underestimate (NMFS 200k).

5. Marine Turtles

a. Green Sea Turtle - Threatened

Green turtles are largely found in tropical and subtropical waters (63FR46994). Once abundant throughout the Caribbean, green turtle populations have significantly declined from historic levels and, as a result, the green turtle was listed as threatened under the ESA (except for Florida coast and Pacific coast of Mexico breeding populations, which are listed as endangered) on July 27, 1978 (63FR46994).

The green sea turtle is unusual in that it is carnivorous during its juvenile period while as an adult it is vegetarian. Its adult diet consists primarily of sea grass. Although green sea turtles live most of their lives in the ocean, adult females return to their natal beach to nest. Green turtles, who sexually mature at 20 to 50 years old, often travel great distances from their feeding to nesting grounds.

In the continental US, green sea turtles are found from Texas to Massachusetts and throughout the North Pacific, ranging as far north as Alaska and British Columbia (NMFS 2001d). In the eastern North Pacific green turtles have been found from Baja California to southern Alaska (NMFS 2001d). According to NMFS (2001d) total population estimates for the green sea turtle are unavailable, but NMFS has concluded that the species status has not improved appreciably since listing.

The greatest cause of decline in green sea turtle populations is commercial harvest for eggs and food; in addition, turtle parts are used for leather and jewelry (NMFS 2001d). Incidental catch from commercial shrimp trawling boats is another source of mortality (NMFS 2001d). Development along coastal areas can also cause mortality through changes in nesting habitat (for example, erosion, sand compaction, and nesting female or hatchling disturbance) while artificial lighting can disorient hatchlings and cause females to avoid heavily lighted areas, minimizing available nesting sites (NMFS 2001d).

In the marine environment, a number of threats to mortality can occur, including: dredging, which can result in habitat destruction; consumption of marine debris, such as plastic and styrofoam; commercial fishing, through entanglement with fishing gear, including longline, hook and line, purse seine, gill, trammel, and pound net fisheries; and, collision with recreational or commerical boats and ships (NMFS 2001d). Pesticides, heavy metals, and PCB's have been detected in turtles and eggs, but their effect is as yet unknown (NMFS 2001d). In addition, oil spills continue to be a threat to green sea turtles (NMFS 2001d). Lastly, illegal take continues to be a problem, especially in the Caribbean, near Puerto Rio (NMFS 2001d).

b. Leatherback Sea Turtle - Endangered

Listed as endangered June 2, 1970, leatherback sea turtles may be one of the most widely distributed reptiles, ranging through the tropical waters of the Atlantic, Pacific, and Indian oceans, where its primary nesting beaches are located, to areas of the North Pacific, North Atlantic, and the Mediterranean Sea, including Alaska and British Columbia (Ernst et al. 1994, 90). NMFS defines the range of the subspecies *Dermochelys coriacea* as extending from Cape Sable, Nova Scotia, south to Puerto Rico and the U.S. Virgin Islands (NMFS 2001e).

Leatherbacks are carnivorous and feed on invertebrates, algae, and vertebrates; their preferred prey is jellyfish but they also consume sea urchins, octopi, quid, snails, bivalves, small fish, and kelp (Ernst et al. 1994, 99). Both juveniles and adults are pelagic species, though they may occasionally enters the shallow waters of bays and estuaries (Ernst et al. 1994, 91).

Little is know about the behavior of leatherbacks, and most information available is about the nesting behavior of females (Ernst et al. 1994, 91). Nesting occurs from September through March along the Pacific coast of Mexico and Central America. After the nesting season, leatherbacks follow schools of jellyfish from temperate to tropical waters.

Population estimates are unclear, though estimates of the number of nesting females place the number at 115,000 (Ernst et al. 1994, 100) or 20,000 to 30,000 (NMFS 2001e). Populaitons are declining in many areas of the world. Terrestrial threats to leatherbacks include: poaching for eggs and meat; nest loss due to erosion, weather, development, beach nourishment, and beach raking; and, disturbance of females and nests due to nighttime use of beaches and artificial lighting. In the marine environment, threats include: entanglement in fishing gear; consumption of marine debris; boat collisions; and, oil spills.

c. Loggerhead Sea Turtle - Threatened

Listed as threatened on July 28, 1978, the loggerhead is the largest hard-shelled turtle, with the adult's carapace measuring from 85-100 cm and weight averaging 155 kg. Some have been recorded, however, with 213 cm long carapaces and weights of over 453 kg (Ernst et al. 1994, 59). In the Pacific, loggerheads are found as far north as Alaska with occasional sighting along the coast of Washington. However, loggerheads are found around the world, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters (NMFS 2001f). They rarely venture further than 240 km out into the open sea (Ernst 1994, 61).

The loggerhead is omnivorous and commonly searches for food in coral reefs, rocky places, and old boat wrecks (Ernst 1994, 70). Its primary prey includes sponges, hydroids, jellyfish, squid, cuttlefish, snails, bivalves, shrimp, crabs, sea urchins, fish, amphipods, young turtles, insects, algae, and vascular plants (Ernst 1994, 70). Many of the loggerheads prey are bottom dwellers, though some are also found in the water column (Ernst 1994, 70).

Mating occurs in late March to early June (NMFS 2001f). Primary loggerhead nesting sites in the US are found along the east coast of Florida, with other sites in Georgia, the Carolinas, and the Gulf Coast of Florida (NMFS 2001f). The only known breeding area in the North Pacific is in Japan (NMFS 2001f).

A NMFS recovery team found that nesting trends for the loggerhead are declining not only in the US but also in Honduras, Mexico, Colombia, Israel, Turkey, Bahamas, Cuba, Greece, Japan, and Panama (NMFS 2001f). While remaining the most populous sea turtle in North American waters, an accurate estimate of the total population is difficult as much information is based on numbers of nesting females. The loggerhead population faces numerous threats with the most significant being coastal development, commercial fisheries, and pollution (NMFS 2001f). Shrimp trawling is also considered a factor in the loggerheads decline (NMFS 2001f). Other terrestrial and marine threats are similar to those faced by the leatherback turtle (above).

d. Olive Ridley Sea Turtle - Threatened

The olive ridley sea turtle was listed as endangered for the "Mexican nesting population" and threatened for all other populations on July 28, 1978. A tropical species, it is found in the tropical waters of the Indian and Pacific oceans (Ernst 1994, 83). Along the Pacific coast, the olive ridley is found along the Oregon coast and may even reach the Gulf of Alaska during El Nino years (Ernst 1994, 83). It is also found in Atlantic Ocean, along the western coast of Africa and the coast of eastern South America (Ernst 1994, 83). Occasionally spotted in the open sea, the olive ridley tends to be found within 15km of the shore (Ernst 1994, 84).

The olive ridley is a small sea turtle, with a hard, olive carapace (Ernst 1994, 83).

Female carapace length ranges from 62 to 74 cm in Surinam, 58 to 74 cm in Pacific Honduras, and 56 to 78 cm in Pacific Mexico (NMFS 2001g). Though geographic variation among olive ridleys is small (no subspecies are recognized), carapace coloration can vary, being lighter in the Atlantic than in the Pacific (NMFS 2001g).

The olive ridley is mainly carnivorous, and much of its prey are invertebrates that can be caught in shallow marine waters or estuarine environments (Ernst 1994, 87). Prey includes jellyfish, sea urchins, bivalves, snails, shrimp, crabs, rock lobsters, algae, and occasionally adult fish (Ernst 1994, 87).

Many olive ridleys nest in *arribadas*, or large nesting groups, which may help to protect against predators (NMFS 2001g). Females may nest up to three times a season. Timing of nesting varies with location, and olive ridley nest every month of the year depending on their range (Ernst 1994, 86). Nesting sites for the olive ridley vary. In the Pacific, nesting takes place along the coast of Mexico and south to at least Colombia (NMFS 2001g).

NMFS states, "...it is probable that the olive ridley is, in terms of absolute numbers of adult individuals in existence, the most abundant sea turtle species in the world" (NMFS 2001g). However, since its listing in 1978 there has been a decline in the species, with populations in the western North Atlantic decreasing by more than 80% since 1967 (NMFS 2001g). Primary threats to this species include direct harvest of adults and eggs, incidental capture in commercial fisheries, and loss of nesting habitat (NMFS 2001g). Other threats include oil spills, consumption of marine debris, and boat collisions (NMFS 2001g). In addition, pesticides, heavy metals, and PCB's have been found in adults and eggs though the effect on the olive ridley is not known (NMFS 2001g).

III. ADOPTED ACTIONS

The following sections describe the WQS revisions which have been adopted by the State of Washington and reviewed and appraised by EPA, followed by a discussion of the potential effect of each revision on the species listed or proposed for listing as threatened or endangered under the Endangered Species Act.

A. SURFACE WATER QUALITY CRITERIA - NUMERIC CRITERIA

1. Introduction

EPA's Water Quality Standards regulations require the states to adopt water quality criteria that will protect the designated uses of a waterbody. These criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated uses. Since 1980, EPA has been publishing criteria development guidelines and national criteria guidance for numerous pollutants. EPA's criteria documents evaluate the toxicity of the chemical, tabulate the relevant acute and chronic toxicity information, and derive the acute and chronic criteria that EPA recommends for the protection of aquatic life resources.

States may choose to adopt the EPA's recommended criteria or modify these criteria to account for site-specific or other scientifically defensible factors.

Water quality criteria for aquatic life contain two expressions of allowable magnitude: a criterion maximum concentration (CMC) to protect against acute (short-term) effects; and a criterion continuous concentration (CCC) to protect against chronic (long-term) effects. EPA derives acute criteria from 96-hour or shorter tests of lethality or immobilization. EPA derives chronic criteria from longer term (often greater than 28-day) tests that measure survival, growth, or reproduction.

The quality of an ambient water typically varies in response to variations of effluent quality, stream flow, and other factors. Organisms in the water body are not typically receiving constant, steady exposure but rather are experiencing fluctuating exposures, including periods of high concentrations, which may have adverse effects. Thus, EPA's criteria indicate a time period over which exposure is to be averaged, as well as an upper limit on the average concentration, thereby limiting the duration of exposure to elevated concentrations. For acute criteria, EPA recommends an averaging period of 1 hour. That is, to protect against acute effects, the 1-hour average exposure should not exceed the CMC. For chronic criteria, EPA recommends an averaging period of 4 days. That is, the 4-day average exposure should not exceed the CCC.

To predict or ascertain the attainment of criteria, it is necessary to specify the allowable frequency for exceeding the criteria. This is because it is statistically impossible to project that criteria will never be exceeded. As ecological communities are naturally subjected to a series of stresses, the allowable frequency of pollutant stress may be set at a value that does not significantly increase the frequency or severity of all stresses combined.

EPA recommends an average frequency for excursions of both acute and chronic criteria not to exceed once in 3 years. In all cases, the recommended frequency applies to actual ambient concentrations, and excludes the influence of measurement imprecision. EPA selected a 3-year average frequency of criteria exceedence with the intent of providing for ecological recovery from a variety of severe stresses. This return interval is roughly equivalent to a 7Q10 design flow condition. Because of the nature of the ecological recovery studies available, the severity of criteria excursions could not be rigorously related to the resulting ecological impacts. Nevertheless, EPA derives its criteria intending that a single marginal criteria excursion (i.e., a slight excursion over a 1-hour period for acute or over a 4-day period for chronic) would require little or no time for recovery. If the frequency of marginal criteria excursions is not high, it can be shown that the frequency of severe stresses, requiring measurable recovery periods, would be extremely small. EPA thus expects the 3-year return interval to provide a very high degree of protection (EPA, 1994).

The National Toxic Rule (NTR) originally promulgated criteria for metals as total recoverable metals. Following EPA's promulgation of this rule, EPA issued a new policy for setting water quality criteria for metals. On May 4, 1995 EPA issued a stay on the effectiveness of metals criteria promulgated in the NTR and promulgated revised criteria expressed in terms of dissolved metals (EPA, 1995). At this time, EPA also promulgated conversion factors for converting between dissolved and total recoverable criteria. States, when adopting criteria, may choose to adopt metals criteria measured as either dissolved or total recoverable. The metals criteria in the Washington Water Quality Standards are expressed as dissolved metals. The criteria under review in this biological assessment are listed in Table 2. As mentioned above, the cyanide criterion is site specific.

Table 2. Washington Water Quality Standards		
Parameter	**Saltwater Criteria**	
	Acute	**Chronic**
Copper	**4.8 ☞g/L**	**3.1 ☞g/L**
Cyanide[1]	**9.1 ☞g/L**	**2.8 ☞g/L**

a. Methods for Determinations

The effect analyses for numeric criteria assume that the organisms are exposed to concentrations of pollutants at the water quality criterion, not the conditions which currently exist in Washington’s waters. Due to the temporal and spatial variability in water quality conditions throughout the state, this assessment will only analyze potential effects at the criterion concentrations. This method of analysis will be conservative on the side of the species for the majority of the State’s waters which contain pollutant concentrations well below the criterion level.

Determinations regarding the potential for the criteria established by the Washington State Water Quality Standards to adversely affect threatened and endangered species were made as follows. Acute criterion was compared to published toxicity data where exposure durations were less than or equal to 96 hours. Chronic criterion was compared to published toxicity data where exposure durations were greater than 96 hours. While the scientific community does not agree on precise definitions for the terms acute and chronic, the general approach used here can offer an adequate assessment of the criterion’s potential effects on aquatic species.

A “may be likely to adversely affect” determination may be made if 1) no information was available detailing the toxicity of the chemical with regard to the species of concern (or a surrogate species) or 2) the published toxicity data indicated adverse effects at concentrations at or below the established criteria. A “not likely to adversely affect” determination was made if the published toxicity data indicated adverse effects at concentrations above the established criteria or if the exposure routes appeared to be minimal. Adverse effects on species were

[1]Applicable only to marine waters which are east of a line from Point Roberts to Lawrence Point, to Green Point to Deception Pass, and south from Deception Pass and of aline from Partridge Point to Point Wilson.

divided into sublethal and lethal effects. Sublethal effects included any measurable or observable effect on a species, not including mortality, while lethal effects consisted only of mortality. Both lethal and sublethal effects were evaluated for each criterion.

b. Uncertainty Analysis

Water quality criteria are designed to provide protection at a large scale. They are not designed to fit all conditions and all species. As such, water quality criteria include a number of assumptions, defaults, and simplifications which results in some uncertainty in EPA's determinations. First, EPA's use of all relevant data under a standard methodology is an attempt to reduce uncertainty in study design or results. However, this may result in the elimination of single studies which may identify critical pathways of exposure or toxicological endpoints not accounted for by the method of combining study results. Thus, in an attempt to assure high quality data are included in this combined approach, EPA's method may eliminate the lowest effect concentration reported in the literature.

Second, the analysis of the potential effects of toxic pollutants on threatened and endangered species included the examination of research conducted primarily with surrogate species. The surrogate species were selected as the closest related organism for which information was available. The best surrogates would live in the same environment and consume the same food as the listed species. For example, little research exists describing the effects of toxic chemicals on chinook and sockeye salmon, but a wealth of information exists describing the effects of toxic chemicals on rainbow trout. Therefore, rainbow trout often served as a surrogate species to determine the effects of toxic pollutants on chinook and sockeye salmon.

Third, the Washington Water Quality Standards do not take into account the interactions between two or more chemicals which could be present in a water body. Some chemicals may interact resulting in more or less toxicity of one or more of the chemicals involved. Some metals such as cadmium and selenium exhibit antagonistic relationships with respect to toxicity (Furness and Rainbow, 1990). The literature provides little evidence to indicate synergistic interactions between metals (Furness and Rainbow, 1990). Synergism is defined as the interaction of toxicants resulting in greater toxicity than that predicted by the sum of the toxicities of each chemical. However, pollutant discharges such as those released by permitted dischargers are unique mixtures of elements. Research studies generally focus on the most abundant elements without reference to others present in a complex mixture. Synergistic, antagonistic, and additive biological effects are possible for species exposed to mixtures. Categorizing elemental mixtures as synergistic, antagonistic, or additive depends on the element concentrations, solubility, and ratios to other elements, as well as the water hardness, measured parameters, species considered, and other factors (EPA 2001).

One way to account for the interactions of contaminants is to use the Toxic Unit approach (see Pulley et al. 1998 and Wildhaber and Schmitt 1998 for examples) or the Hazard Quotient method (EPA 1998a). On a statewide basis, this approach would be neither practical nor relevant; however, on a site-specific basis, mixtures can be defined. At the present time, EPA water quality criteria do not account for addivity of exposure for multiple contaminants.

c. Organization of Determinations

For each of the chemicals, the determination section is organized as described here: a preliminary description of the chemical and criteria followed by an evaluation of recent research on each of the species of concern or their surrogates. The species are considered together in phylogenetic groups such as fish, birds, and mammals.

2. NUMERIC CRITERIA FOR TOXIC SUBSTANCES

a. Copper

The revised Washington Water Quality Standards set marine acute and chronic criteria for copper of 4.8 ☞g/L and 3.1 ☞g/L, respectively. These criteria apply to all marine waters in Washington State territory.

Copper is used to manufacture electrical equipment, pipe, and machinery (Eisler 1998). Releases to the global environment, which may approach 1.8 million metric tons per year, are largely caused by anthropogenic activities such as mining and smelting, industrial emissions and effluent, and municipal waste and sewage sludge (Eisler 1998). Copper is also used as a biocide and in agricultural fertilizers, medical products, and the food industry (Eisler 1998). Free ionic copper (Cu^{2+}), the form generally encountered in water, is the most readily available and most toxic inorganic species of copper in seawater (EPA 1984, Eisler 1998). In seawater, the major chemical species of copper are $Cu(OH)Cl$ and $Cu(OH)_2$. These species account for 65% of total copper in seawater (Eisler 1998). Over the entire ambient pH range, copper hydroxide ($Cu(OH)_2$), copper carbonate ($CuCO_3$), and cupric ion (Cu^{2+}) are the dominant copper species (Eisler 1998). While copper may form complexes with suspended organic matter, it will ultimately settle out of the water column and be deposited in the sediment (EPA 1984).

Copper is among the most toxic of the heavy metals and often accumulates and causes irreversible harm to some species just above levels required for growth and reproduction (Eisler 1998). Birds and mammals are relatively resistant to copper when compared to lower life forms (Eisler 1998). Bioavailability and toxicity of copper to aquatic organisms depends on the total concentration of copper, its speciation, salinity, water hardness, depth, water temperature, pH, the total organic content in the aquatic system, and the type and life stage of the exposed organisms (EPA 1999, Eisler 1998). Factors affecting copper accumulation in marine species include type of species, size, age, and developmental stage, with lower concentrations found among vertebrates (Eisler 1998). The distinction between deficiency and toxicity for copper is small for organisms that do not have effective mechanisms to control the absorption of copper (e.g. fungi, algae, and invertebrates) (EPA 1999).

Bioconcentration and Biomagnification

Copper is not strongly bioconcentrated (an increase in concentration of a substance in relation to the concentration in the ambient environment) in vertebrates, but is more strongly bioconcentrated in invertebrates. Bioconcentration factors (BCFs) reported in the EPA (1984) water quality criteria document for copper ranged from zero in bluegill (*Lepomis macrochirus*) to 22,600 in asiatic clams (*Corbicula fluminea*).

In salmonids, the accumulation of copper in muscle, kidney, and spleen tissues occurred at copper concentrations ranging from 0.52-3 ☞g/L in both seawater and freshwater (Camusso and Balestrini 1995; Peterson et al. 1991; Saiki et al. 1995). While the concentrations of copper in fish tissues reflect the amount of bioavailable copper in the environment, EPA has concluded that, when determining sublethal effects to invertebrates and fish, bioconcentration will not be classified as an effect (EPA 1999). Effects may occur as a result of the bioconcentration, and throughout this document where the studies reviewed illustrated effects coincident with bioconcentration we have included that information in the sections detailing effects to organisms. Otherwise, when the results of the studies reviewed included only bioconcentration of contaminants, information regarding those studies was described in the general "Bioconcentration and Biomagnification" section for each chemical.

There is little information available concerning biomagnification (a progressive increase in concentration from one trophic level to the next higher level) of copper in aquatic food chains. Also, since the literature describing the effects of copper on birds or mammals is minimal, there is little information from which to quantify the biomagnification of copper. Baudo (1983), Wren et al. (1983), and Mance (1987) have all concluded that copper does not biomagnify in the aquatic environment.

Evidence of biomagnification in birds is divided: St Louis et al. found that tree swallows nesting near acidified aquatic ecosystems accumulated sufficient copper from their diet to induce elevated hepatic metallothionein concentrations, while van Eeden and Schoonbee found no evidence of biomagnification in the sediment food chain of sediment-pondweed-red-knobbed coot (Eisler 1998, St. Louis et al 1993, van Eeden and Schoonbee 1993). In addition, Bryan and Langston find that, in general, birds retain very little of the copper and other metals ingested (Bryan and Langston 1992).

Fish

In fish, greater entry of copper to the intracellular compartment is caused by the gill surface's lower affinity for metal (Eisler 1998). A number of toxic mechanisms can result: blocking of the essential biological functional groups of biomolecules; displacement of the essential metal ion in molecules; and, modification of the active conformation of molecules (Eisler 1998). Long term retention of copper in fish tissue is marked by high half-timepersistence after exposure to copper; copper detoxifying mechanisms include the induction of metallothioneins, allowing copper retention for weeks or months after absorption without toxic effects (Eisler 1998). Copper can also interfere with osmoregulation (Eisler

1998). Elevated concentrations of copper can disrupt gill function and interfere with oxygen transport and energy metabolism, causing tissue hypoxia (Eisler 1998). Copper concentrations in tissues of marine vertebrates tends to decrease with the increasing age of the organism (Eisler 1998).

<u>Sublethal Effects</u>

Macrophages play an important role in the immune system of fish. Bennani et al. (1996) examined the effects of exposure of macrophages to sublethal concentrations of copper. The study examined two phagocytes-mediated activities of the sea bass following exposure to a sublethal dose of copper, and found that *in vivo* exposure for 48 hours did not affect the quantity of phagocytes but did inhibit, in a dose dependent manner, two mechanisms responsible for the destruction of foreign material: phagocytosis and the production of reactive oxygen intermediaries, or ROI's (Bennani et al. 1996). Inhibition occurred at doses of between 50 ☞g/kg (or 50 ppb) and 1 mg/kg (or 1 ppm) copper. The process of phagocytosis has been established as the primary defense mechanism in fish while ROI's are cytotoxic mediators essential for oxygen-dependent antimicrobial defense in several species of fish (Bennani et al. 1996). The kidney, which plays an important role in detoxification and excretion of metal pollutants, is particularly rich in macrophages.

Scarfe et al. studied the effects of sublethal copper exposure on four marine teleosts: pinfish (*Lagodon rhomboides*), Atlantic croaker (*Micropogon undulatus*), sheepshead (*Archosargus probatocephalus*), and sea catfish (*Arius felis*) (1982). For each species, behavioral variables (general activity, swimming speeds, and angular orientation of movements) were affected by exposure to 0.1 mg/L (or 100 ☞g/L) Cu^{2+} in different ways. Scarfe et al. (1982) concluded that

> sublethal copper concentrations had little or no effect on the activity of pinfish while some individual croaker showed hypoactivity after 72 hours of exposure. Sheepshead and sea catfish showed greater sensitivity, with both species becoming hyperactive, to slightly differing degrees, immediately after exposure. The activity of sheepshead appeared to return to normal levels within two weeks after the exposure, while sea catfish became dramatically hypoactive and 60% died within 1 to 3 weeks after exposure.

Veena et al. have studied the effects of copper on ovarian development of an estuarine fish from the southwest coast of India, the cichlid *Etroplus maculatus*, concentrating on three maturity stages: immature virgins, maturing, and ripe (1996). At a temperature of 28☜ C ± 2, pH 6.8 ± 0.1, and dissolved oxygen of 7.2 ml/L, cichlid were exposed to copper at 0.005 ppm, or 5 ☞g/L. The authors found that the "ovaries of the fish were observed to be severely affected by 96 hours of exposure" (Veena et al.1996). Copper did not cause any change in the chromatin-nucleolus stage, though it did rupture the cell membrane in the perinucleolus and yolk stage (Veena et al. 1996).

Veena et al (1997) also examined sublethal copper concentrations in a later study. The researchers found that, at a copper concentration of 5 ☞g/L, Bloch *(Etroplus maculatus)* did not exhibit any behavioral signs of stress, though copper did induce variations in concentrations of sialic acid in the pituitary gland, variation in ovary cholesterol concentration, and marked depletion of glycogen reserves.

The sublethal copper concentrations reported in both the studies by Veena (1996 and 1997) are close to Washington's chronic marine copper criterion. However, the Bloch used in the studies were field collected from the Cochin estuary in India, which is contaminated by copper, selenium, and mercury from industrial activities in the Greater Cochin industrial belt.

To examine the effects of sublethal exposure to copper on the behavior of two marine teleosts - sea catfish *(Arius felis)* and sheepshead *(Archosargus probatocephalus)* - Steele (1985) electronically monitored the movements of these fish after 72-hour static exposure to 100, 200, and 300 ☞g/L copper. Both species showed significant initial hyperactivity, while one week later fish exhibited significant extreme hypoactivity. Latent hypoactivity is considered a sign of delayed toxic response and, in this study, was assumed to be the result of physiological stress due to the initial hyperactivity and physiological damage because of the treatment with copper.

Taylor has done a review of data on marine copper toxicity to a number of marine teleosts (Taylor 1977). For Atlantic herring *(Clupea harengus)*, hatching of eggs is inhibited between 80 and 100 ☞g/L and larval development is inhibited at approximately 30 ☞g/L. Shiner perch *(Cymatogaster aggregata)* suffer enzyme inhibition at approximately 8,000 ☞g/L while the mummichog *(Fundulus heteroclitus)* exhibits similar results at approximately 400 ☞g/L. Feeding is inhibited in the plaice *(Pleuronectes Platessa)* at 100 ☞g/L and growth at 10 ☞g/L.

<u>Lethal Effects</u>

According to the EPA's 1984 Water Quality Criteria document for copper, acute values for saltwater fishes ranged from 13.93 to 411.7 ☞g/L, with the lowest value obtained in a test on embryos (EPA 1984a). In addition, a 4-day LC50 of 10 ☞g/L resulted from tests with Atlantic cod (EPA 1984a).

Veena et al. (1997) tested acute effects of copper on an estuarine teleost, Bloch *(Etroplus maculatus),* using a range of lethal test concentrations: 40 ☞g/L, 50 ☞g/L, 60 ☞g/L, and 70 ☞g/L . Mortality was recorded at 24 hour intervals over a 96-hour time period. LC50 results of the acute static bioassays were:

Concentration (☞g/L)	Cumulative percentage mortality	96h LC50 values (95% confidence limits)
40	20	0.05
50	40	0.05 - 0.06
60	80	

70	80	

Fish progressively exhibited irregular swimming, frequent surfacing, gulping of air, convulsions, etc. with abnormalities attributed to the impairment and blockage of transmission between nervous system and various effector sites as a result of treatment with copper.

Using a flow-through seawater system, Letourneau examined the effects of copper on shiner perch *(Cymatogaster aggregata)* and coho salmon *(Oncorhynchus kisutch)* (Letourneau 1982). The 96-hour LC50 for adult perch was 417.83 ☞g/L and for salmon smolt 601.00 ☞g/L.

Cardeilhac et al. examined the effects of 8.5 ppm (8500 ☞g/L) cupric ion on sheepshead *(Archosargus probatocephalus)* in sea water during a 12 to 17 hour experimental period (1979). Major morphological effects were swollen and congested kidneys, gill lamellar thickening, and capillary congestion. In addition, physiological alterations in respiratory rate and serum electrolyte levels, indicating osmoregulatory failure.

Taylor has done a review of data on marine copper toxicity to a number of marine teleosts (Taylor 1977). For anchovy, the 48-hour LC50 for the egg stage is 200 ☞g/L and between 700 and 800 ☞g/L for adults. For the Atlantic herring *(Clupea harengus)*, the 48-hour LC50 for eggs is approximately 50 ☞g/L and for larvae between 1,000 and 2,000 ☞g/L. The 96-hour LC50 for the mummichog *(Fundulus heteroclitus)* ranges from 3,000 - 20,000 ☞g/L. For the Florida pompano *(Trachinotus Carolinus)* the juvenile 96-hour LC50 is approximately 2,000 ☞g/L.

In addition, Ronald Eisler has done an extensive review of the literature on the lethal effects of copper, finding that, of all saltwater species studied, including fish, the most sensitive to copper have 96-hour LC50 values of 28 to 39 ☞g/L (Eisler 1998). This includes the summer flounder (*Paralichthys dentatus*) with a 96-hour LC50 of 28 ☞g/L during a test with embryos (USEPA 1980).

Based on the available information, EPA has determined that approval of the **marine acute and chronic copper criteria is not likely to adversely affect chinook, chum, sockeye, steelhead, and coho salmon; sea-run cutthroat trout; bull trout; and Dolly Varden.**

Birds

As Eisler notes, copper can indirectly affect birds by diminishing prey species (Eisler 1998). The analysis of the criteria did not address the effects of the criteria on prey items of individual species or on their habitat beyond the water column. Toxic chemicals may affect aquatic organisms via ingestion (of contaminated prey or sediment particles) or through absorption (from water or from sediment). Furthermore, prey populations may decrease as a result of chemical contamination, thus depriving a species of food sources. This analysis included effects for many prey species and should adequately protect prey of the listed species examined in this document.

Eisler states that no data is available on copper toxicity to avian wildlife, and all studies with birds and copper use domestic chickens, ducks, or turkeys (Eisler 1998). Experiments with domestic poultry show that copper accumulates in the livers of mallard ducklings at dietary concentrations as low as 15 mg Cu/kg daily weight (DW) ration; that growth of turkey poults is inhibited at 120 mg Cu/kg DW ration and improved at 60 mg Cu/kg DW ration with signs of gizzard histopathology at 500 mg Cu/kg DW ration; and a reduction in weight gain and gizzard histopatholgy occurs in chicks at 250-350 mg Cu/kg DW ration (Wood and Worden 1973; Poupoulis and Jensen 1976; National Academy of Sciences 1977; Kashani et al. 1986)

To determine the effects of the maximum allowable water concentration for copper on birds, this water concentration was converted to dietary concentrations using the maximum bioconcentration factor (BCF) reported for fish by the EPA (see EPA 1984a) (for more information on methods, see Appendix D). This allows for an interpretation of the dietary concentrations referenced above. The minimum dietary concentration at which effects were observed is 15 mg Cu/kg. The highest fish BCF reported in EPA's 1984 criteria document for copper is 290, for the larva of the freshwater flathead minnow (EPA 1984a). There are no BCFs reported for saltwater fish species. Even at the maximum allowable water criteria, birds would not consume a dietary copper concentration greater than those discussed above (see Table 3 below). Therefore, EPA has determined that approval of the **marine acute and chronic copper criterion is not likely to adversely affect bald eagle, marbled murrelet, short-tailed albatross, brown pelican, and western snowy plover.**

Table 3. Dietary Concentrations Allowed by Washington Water Quality Standards

Dietary Concentrations		Copper Criteria		Maximum BCF for fish, as prey for birds (EPA 1984a)
Acute	Chronic	Acute	Chronic	
1.392 mg Cu/kg	0.899 mg Cu/kg	0.0048 mg Cu/L	0.0031 mg Cu/L	290

Marine Mammals

Whales

There are three routes for the uptake of metals by cetaceans (Bowles 1999). The primary route is dietary. Accumulation through the skin has been reported, but is likely of less importance as cetacean skin is an effective barrier, unless lesions are present (Bowles 1999). The pulmonary route is also likely insignificant, though it is possible for the direct incorporation of metals from those present in the atmosphere (Bowles 1999). Metals digested through diet will be transported to the soft tissues by the blood system (Bowles 1999). For baleen whales (suborder *Mysticeti)* and toothed whales (suborder *Odontoceti),* the liver consistently contains the highest level of copper (Bowles 1999).

Bioaccumulation and biomagnification of metal in cetaceans primarily occurs through diet, and varies from species to species. Metal accumulation will likely be higher in toothed whales than baleen whales, as the former relies more than baleen whales on fish as a prey species, are found more than baleen whales in coastal areas, and are higher on the food chain than baleen whales (Bowles 1999). Species-species differences also occur as a result of diet; for example, krill carry higher levels of cadmium than fish, and cadmium levels are higher in krill-eating minke than fish-eating cetaceans (Bowles 1999).

For mammals, copper homeostasis helps prevent copper toxicity: excess copper absorbed into the gastrointestinal mucosal cells is bound to metallothionein and excreted, with copper that is not absorbed in the intestine stored in the liver, incorporated into bile, or excreted (Eisler 1998). Research presented at the annual meeting of the International Whaling Commission in 1999 suggests that this process also occurs in marine mammals (Rayl 1999). Researchers examining brain, liver, and kidney tissues from the bowhead whale (*Balaena mysticetus*) during annual subsistence hunts by the Inuits found high levels of heavy metal contamination (Rayl 1999). Similar high levels in terrestrial mammals would lead to significant impairment; however, the whales did not seem to exhibit adverse effects (Rayl 1999). Researchers, hypothesizing that these cetaceans must have a protective mechanism, have discovered that, in the bowhead, the metallothionein protein--the binding site for heavy metals and some other toxins--is homologous to the human metallothionein protein, with the kidneys eventually becoming the storehouse for toxins (Raye 1999). This result is corroborated by Bowles (1999), who states that the sequestration of free ions of metals by metallothionein has been recorded, with copper having a high binding affinity.

In marine mammals, concentrations of copper decrease with increasing age, except for brain copper concentrations, which increase with age (Eisler 1984). However, according to Aguilar et al. (1999), copper often shows modest increases with age in whales, though in some cases it may be stable throughout the life of the individual or may decrease. Neonatal marine mammals have higher concentrations of copper than those found in mother, as portions of the copper load are transferred to offspring during lactation and gestation (Law et al. 1992).

In 1999, the International Whaling Commission (IWC) produced a special issue of the Journal of Cetacean Research and Management focusing on chemical pollutants and cetaceans. The issue was based on a Workshop on Chemical Pollutants and Cetaceans held in Bergen in March 1995. As cetaceans are long-lived, have extensive fat stores, and are often top predators, some species carry tissue pollutant levels that are among the highest recorded (Reijnders at al. 1999). Concern over this issue led to three decades of effort into the dynamics of chemical pollutants in marine mammals (Reijnders 1999). Two types of effects of chemical pollution on cetaceans were examined during the Bergen Workshop: direct (including lethal and sublethal) and indirect effects.

According to the Bergen Workshop, there is no indication of acute poisoning of cetaceans (Reijnders et al. 1999). Gina Ylitalo (2002) of NMFS states that, according to the CRC Handbook of Marine Mammal Medicine (Dierauf and Gullen 2001), copper has not been implicated as a potential toxin in marine mammals. A study by O'Shea et al. (1994) cited in the

CRC Handbook found that the use of copper herbicides might be hazardous to the Florida manatee; however, the potential was found only in certain feeding areas where intensive pesticide use occurred.

Sublethal effects on whales include: increased susceptibility to disease; impairment of reproduction and early development; immune suppression; cancer induction and mutagenic effects; changes in behavior; and occurrence and extent of epizootics (Reijnders et al. 1999). The primary chemical threat to cetaceans is through the uptake of persistent lipophilic contaminants through the food chain. For more water soluble trace elements, exposure through water may also be significant (Reijnders et al. 1999a). Indirect effects on cetaceans include, most importantly, the role of pollutants on cetacean prey species and exposure to pollutants through prey species (Reijnders et al. 1999).

There is a lack of data on the effects of chemical pollutants on cetaceans. In the absence of this data, it is difficult to assess the impact of specific levels of pollutants on whales. For example, much available data on cetaceans focuses on tissue pollutant levels, and it is difficult to draw a relationship between these levels and their potential harmful effects at the individual and population levels (Reijnders et al. 1999). For a number of reasons, it is not possible to conduct tests on lethal and sublethal effects on live whales.

As a result, the IWC concluded that "a considerable amount of fundamental research is needed to adequately address the question of the effects of pollutants on all cetaceans" (Reijnders et al. 1999). However, the report also concluded that "there are sufficient data on adverse effects of pollutants on other marine mammals and terrestrial species to warrant concern for cetaceans" (Reijnders et al. 1999).

A National Oceanic and Atmospheric Administration (NOAA) technical memorandum indicates that, in the Puget Sound, the Straits of Georgia, and off the coast of Washington, the concentrations of chemical contaminants in tissues of bottom feeding gray whales were substantially lower than the concentrations measured in certain pinnipeds and toothed cetaceans whose diets consist largely of fish (Varanasi 1993).

The NOAA memo finds that "for stranded gray whales sampled from several areas on the West Coast of the United States...the concentrations of a broad spectrum of anthropogenic contaminants [including copper] were relatively low in all of the whales analyzed" (Varanasi 1993). The gray whale is a baleen whale, as are the majority of whales considered in this document (blue, fin, sei, and humpback), and share common feeding patterns and prey. The gray whale is unique in that it is a bottom feeder and the NOAA memo attributes higher levels of toxins in the gray whale to their greater ingestion of sediments. However, the sperm whale belongs to the order *Odontoceti*, and the NOAA document will be less applicable to their situation, as copper toxicity could be greater due to their greater consumption of fish.

The study's findings suggest that the lower concentrations of toxic pollutants, including copper, in baleen whales is consistent with the gray whales' primary food source being invertebrates (Varanasi 1993). This finding can possibly be extrapolated to other baleen whales in Washington. In addition, the levels of copper found in the gray whale were not attributed to anthropogenic environmental causes, suggesting that, for blue, fin, sei, and humpback whales in Washington waters, anthropogenic sources of copper are not a likely cause of mortality.

In conclusion, there is a lack of specific data on the lethal and sublethal effects of copper on whales. The evidence suggests several possible inferences:

- Whales have a mechanism which helps prevent copper toxicity (Eisler 1998);
- Copper does not biomagnify in the aquatic environment (Baudo 1983, Wren et al. 1983, Mance 1987);
- Copper is not strongly bioconcentrated in vertebrates;
- Copper concentrations decrease with increasing age (Eisler 1984); and,
- The primary chemical threat to cetaceans is through the uptake of persistent lipophilic contaminants through the food chain (Reijnders et al. 1999).

However, other factors indicate that concern for the effects of toxic pollutants on cetaceans may be warranted. While acute poisoning of cetaceans in not indicated, and while there is no specific data relating copper to acute and chronic effects, the IWC concludes in their report that sufficient data exists on the effects of pollution on other marine mammals and terrestrial species to warrant concern for cetaceans (Reijnders et al. 1999). John Calambokidis (2002), of Cascadia Research, states that concern about chemical pollutants has focused on anthropogenically released chemicals, such as mercury and DDT. Copper, which also occurs naturally in the marine environment, is less of a concern because marine mammals, including whales, are likely to have developed a mechanism for excreting excess copper (Calambokidis 2002). However, he was uncertain what threat copper posed to whales. Due to the uncertainty in the literature and that expressed by experts (Calambokidis 2002, Ylitalo 2002), the EPA has determined that the approval of the **marine acute and chronic copper criteria may be likely to adversely affect the humpback, blue, fine, sei, and sperm whale.**

Steller Sea Lion

An extensive literature search found no information on the effect of copper on the Steller sea lion. There is no data which links copper exposure to specific effects in the sea lion.

Principal threats to the Steller sea lion include: environmental changes which affect food supply, the commercial harvest of prey species, vessel traffic, and the potential for chemical spills (NMFS 1996a). In addition, NMFS (1996a) has concluded that evidence does not indicate an immediate threat from toxic pollutants under current conditions. However, Tom Loughlin of NMFS (2002) states that while evidence does not indicate that chemical pollution is a cause of the decline in sea lion population levels, it remains a cause of concern.

Consequently, EPA has determined that the approval of the **marine acute and chronic copper criteria may be likely to adversely affect the Steller sea lion.**

Marine Turtles

Sakai et al. (2000) state that, like marine mammals and sea birds, heavy metal concentrations in the green turtle likely vary according to biological processes such as age, sex, reproduction, migration, etc. In their study of heavy metal accumulation in green sea turtles, the authors found that concentrations of copper decreased with growth, which may be related to the green sea turtle's shift in feeding habits (from carnivorous in the juvenile life stage to herbivorous in the adult stage) (Saiki et al. 2000). Saiki et al. (2000) also found that copper concentrations in the liver were high and varied widely. Possible causes cited by the authors were discharges into coastal waters of domestic and industrial wastes, which include heavy metals such as copper (Saiki et al. 2000). The authors hypothesize that "a rapid increase of human and industrial activities in coastal waters may impose a potential toxic effects [sic] for juvenile green turtles, which are just returning to coastal areas, since they accumulate copper in the body at elevated levels" (Saiki et al. 2000).

Godley et al. (1999), in a study of marine turtles in the Mediterranean Sea, found that diet also plays a role in concentrations of heavy metals. Their data suggests that concentrations of heavy metals are likely to reflect inter-specific difference in diet. Thus, higher concentrations of metals in loggerhead turtles compared to green turtles is attributed to the loggerhead being carnivorous while the green turtle is herbivorous (Godley er al.1999). The authors further state that differences in heavy metal concentrations between populations may also be explained by prevailing environmental contamination in their foraging ranges and by the age of individuals sampled (Godley et al. 1999).

Like Sakai et al. (2000), Caurant et al. (1999) and Sakai et al. (2000a) also find that distribution patterns of copper in sea turtles is similar to that reported in marine mammals or seabirds. Caurant et al. (1999) found that copper concentrations in the liver of green turtles were much higher than that of loggerhead and leatherback turtles, while muscle and kidney levels were similar. The authors attribute food to be the main source of exposure to heavy metals for marine vertebrates (Caurant et al. 1999).

Lastly, a number of articles discuss the transfer of copper from mother to eggs (Storelli et al. 1998; Sakai et al. 2000a; Godley 1999). It has been hypothesized that excretions of metals via eggs may be a substantial elimination route though, as turtles lay multiple clutches over many years, the amount of the copper burden deposited is unclear (Godley 1999). Storelli et al. (1998) discuss the ease with which copper is transferred from mother to eggs, a route of exposure to copper that can potentially reduce the viability of sea turtle juveniles.

According to NMFS' Robert Pitman (2002), the two types of turtles found in Washington face different threats. Leatherbacks face more serious problems that exposure to pollutants, while hardshells are very rare in Washington (Pitman 2002). The problems facing sea turtles are severe and include fishing by-catch, human disturbance of nests, and the taking of adults for food (Pitman 2002). These issues dwarf any environmental threats, for example aquatic pollution, that sea turtles may face (Pitman 2002).

According to NMFS' Peter Dutton (2002), there is little information on the effects of chemical pollutants on sea turtles, and the role that pollutants play is unknown, though it could be significant. Concern about the effects of pollutants has, however, led to growing interest in conducting research into the issue (Dutton 2002). Despite conservation, the numbers of all sea turtle species considered in this document continues to decline; though little information exists, there is concern about the effects of chemical pollutants (Dutton 2000). Due to this uncertainty, EPA has determined that the approval of the **marine acute and chronic copper criteria may be likely to adversely affect the green, leatherback, loggerhead, and Olive Ridley sea turtles.**

b. Cyanide

The revised Washington Water Quality Standards set marine acute and chronic criteria for cyanide of 9.1 µg/L and 2.8 µg/L, respectively. These criteria apply only to Puget Sound and portions of the Straits of Georgia.

The cyanide criteria are based on the weak acid dissociable method, or free cyanide. Free cyanide measurements are a more reliable indicator of toxicity to aquatic life than total cyanide, as total cyanide measurement includes the relatively stable organic cyanides and metallocyanides. In addition, free cyanide (which refers to the sum of molecular HCN and the cyanide anion CN^-) is the primary toxic agent in the aquatic environment (Eisler 1991). As Peter Doudoroff states, "The observed toxicity to fish of most of the tested, acutely toxic solutions of both simple and complex cyanides...is attributable very predominantly, or almost entirely, to hydrocyanic acid, or HCN, whose concentrations are reliably measurable" (Doudoroff 1976).

Cyanide occurs naturally in the environment, and is produced by a number of species, including bacteria, algae, fungi, and other higher plants (Eisler 1991). Cyanide also occurs in effluent from metal-finishing and metallurgical plants, iron and steel processing plants, petroleum refineries, gas plants, and other synthetic and industrial sources (Doudoroff 1976, Eisler 1991). Relative concentrations of hydrocyanic acid (the more toxic form, HCN) and cyanide ion (CN^-) are dependent on pH and temperature; thus, the toxicity of cyanide may increase with decreasing pH and temperature (Doudoroff 1976).

Bioconcentration and Biomagnification

An extensive literature search found little evidence of bioaccumulation or biomagnification of cyanide in aquatic organisms and food webs. Bioconcentration (the increased concentration of a substance in relation to the concentration in the ambient environment) of cyanide is considered to be negligible in fish because the compound is easily metabolized. However, after 16 weeks exposed to thiocyanate (SCN) at 720 or 89 µg/L or CN^- at 0.98 or 0.32 µg/L, rainbow trout experienced significantly elevated plasma SCN concentrations; the authors concluded that the fish could not "avoid" the contaminated water, because of the contained laboratory setting, and thus could not easily depurate the cyanide (Lanno and Dixon 1996). In nature, fish may have the ability to move to less contaminated habitat.

As reported by EPA (1984), the existing literature does not provide evidence for cyanide biomagnification in the food chain (a progressive increase in concentration from one trophic level to the next higher level). This is likely due to the fact that vertebrate species, such as fish, may readily metabolize cyanide, thus removing cyanide from the food chain at that level.

Fish

<u>Sublethal Effects</u>

There is little information on the sublethal effects of cyanide on marine fish. The EPA's water quality criteria for cyanide uses data on the chronic toxicity of cyanide to one saltwater fish species: sheepshead minnow (EPA 1984). An early life stage test showed that growth was not significantly reduced at a cyanide concentration of 462 ☞g/L though survival was reduced at concentrations of above 45 ☞g/L (Schimmel et al. 1981). Survival was not significantly reduced at levels below 29 ☞g/L, and the chronic value, expressed as CN, was set at 36.12 ☞g/L (Schimmel et al. 1981).

<u>Lethal Effects</u>

There is also little information on the lethal effects of cyanide on marine fish. The EPA has found that, in general, certain life stages and species of fish are more resistant to the effects of cyanide, including embryos, sac fry, and warm water species (EPA 1984).

The EPA's water quality criteria for cyanide uses data on the acute toxicity of cyanide to three saltwater fish species (EPA 1984). Acute values for fish ranged from 59 to 372 ☞g/L. In a flow-through measured test, the LC50 for the sheepshead minnow was 300 ☞g/L (Schimmel et al. 1981). Also in a flow-through measured test, the LC50 for the atlantic silverside was 59 ☞g/L (Gardner and Berry 1981). And, in a static unmeasured test the LC50 for the winter flounder was 372 ☞g/L (Cardin 1980).

24-hour saltwater tests by Alabaster et al. found an LC50 of 20-75 ☞g/L for the Atlantic salmon (Alabaster et al. 1983). 24-hour saltwater tests of the pinfish found an LC50 of 69 ☞g/L (Daugherty and Garrett 1951).

At an average pH of 7.7 and a cyanide concentration of 0.27mg/l (270 ☞g/L) as CN, Broderius (1973) found that threespine sticklebacks (a saltwater fish) exposed to NaCN solutions of equal cyanide content died much sooner in solutions prepared with sea water having a chlorinity of about 16-17 parts per thousand than in solutions prepared with either half-strength diluted sea water or fresh water. In sea water, the median survival period at 20 degrees C was 198 minutes (Doudoroff 1976). The salinity of the sea water used in this study was approximately 30 parts per thousand, below that of oceanic water which averages 35 parts per thousand (Doudoroff 1976). Test results indicate that the greater toxicity for fish in the undiluted sea water was not because of increased salinity but, likely, because of the greater hardness of the sea water.

Based on the information available, EPA has determined that the approval of the **site specific marine acute and chronic cyanide criteria is not likely to adversely affect Puget Sound chinook salmon, Hood Canal summer-run chum salmon, Puget Sound/Strait of Georgia coho salmon, Coastal/Puget Sound and Columbia River bull trout, and Dolly Varden**.

Birds

Birds exhibiting cyanide toxicosis exhibit panting, eye blinking, salivation, and lethargy (Eisler 1991). According to Eisler (1991), birds that feed primarily on flesh, including vultures, owls, and kestrels, are more sensitive to cyanide than species that fed mainly on plant material.

Eisler has done an extensive review of cyanide effects in selected species of birds. Included is a study by E.F. Hill which reports that, at a single oral dose of 0.53 mg CN/kg BW, no deaths in mallards were reported. At 1.1 mg CN/kg BW, 6% of mallards died, at 1.27 mg CN/kg BW 33% died, and at a dose of 1.43 mg CN/kg BW 50% died (LD50).

In a study of the black vulture by Wiemayer et al. (1986), a single oral dose of 1.6 mg CN/kg BW resulted in no deaths. A dose of 2.4 mg CN/kg BW resulted in some deaths within 30 minutes, while a dose of 2.54 mg CN/kg BW was the acute oral LD50. At levels of 3.7 and 19.1 mg CN/kg BW, all vultures were dead within 16 minutes.

In addition, Wiemayer et al. conducted tests on a number of other birds:

Eastern screech owl; acute oral LD50; 4.6 mg CN/kg BW;
Canary; all dead within 3 minutes; 0.12 mg HCN/L air;
Japanese quail; acute oral LD50; 4.5 mg CN/kg BW (adult females);
Japanese quail; acute oral LD50; 5.5 mg CN/kg BW (adult males);
European starling; acute oral LD50; 9.0 mg CN/kg BW;
American kestrel; acute oral LD50; 2.12 mg CN/kg BW;
Rock dove; all dead within 10 minutes; 012 mg CN/kg BW air;
Rock dove; minimum lethal dose when administered intravenously or intramuscularly; 1.6 mg CN/kg BW; and,
Domestic chicken; lethal dose; 0.6 mg CN/kg BW.

Gomez et al. (1988) find that in domestic day-old chicks, fed cassava diets and exposed through dietary routes to 4, 37, 70, and 103 mg total CN per kilogram ration, no significant effects on survival, growth, histology, hemoglobin, hematocrit, or lymphocyte number results, though serum thiocyanate levels increased in a dose-dependent manner. However, a 20-day exposure to chicks fed 135 mg HCN resulted in depressed growth and food intake and an increase in plasma thiocyanate levels (Gomez et al. 1988).

To determine the effects of the maximum allowable water concentration for cyanide on birds, the maximum bioconcentration factor (BCF) for fish is necessary; however, the EPA does not have these factors for cyanide. The sensitivity of bird species is related to diet, and birds that feed on flesh are more sensitive to cyanide toxicity (EPA 1999). However, current available information suggests that cyanide does not bioconcentrate or bioaccumulate in fish tissues, thus making it unlikely that piscivorus birds will ingest cyanide through their diet (EPA 1999).

Another possible pathway of exposure to cyanide for birds is through consumption of drinking water. Pritsos and Ma (1997) found that mallards that ingested water contaminated with 20 mg/L (or 20,000 ☞g/L) displayed sublethal effects. These effects occurred at concentrations 2,000 to 7,000 times Washington's adopted water quality criteria for cyanide. Therefore, EPA has determined that approval of the **site specific marine acute and chronic cyanide criterion is not likely to adversely affect bald eagle, marbled murrelet, short-tailed albatross, brown pelican, and western snowy plover.**

Marine Mammals

<u>Whales</u>

The humpback whale *(Megaptera novaeangliae)* is found in Puget Sound. An extensive literature search found no information on the effect of cyanide on whales. As discussed above, for whales the primary route of exposure to chemicals is dietary. Currently, evidence suggests that cyanide does not bioconcentrate or bioaccumulate in the prey species of whales. Cyanide also breaks down rapidly in the marine environment. In addition, in its analysis of the California, Oregon, Washington, and Mexico humpback whale stocks, NMFS (2000f) finds the causes of human induced mortality for this stock to consist of fishery mortality and ship strikes, and does not mention chemical pollution as a threat. However, due to the lack of data and uncertainty about the effects of cyanide on whales (as expressed by Calambokidis 2002 and

Ylitalo 2002) EPA has determined that the approval of the **site specific marine acute and chronic criteria for cyanide may be likely to adversely affect the humpback whale.**

Steller Sea Lion

The Steller sea lion *(Eumetopias jubatus)* is found in Puget Sound. An extensive literature search found no information on the effect of cyanide on the Steller sea lion. Available evidence suggests that cyanide does not bioconcentrate or bioaccumulate in the prey species of whales. Cyanide also breaks down rapidly in the marine environment. In addition, principal threats to the Steller sea lion include: environmental changes which affect food supply, the commercial harvest of prey species, vessel traffic, and the potential for chemical spills (NMFS 1996a). NMFS (1996a) has concluded that evidence does not indicate an immediate threat from toxic pollutants under current conditions. However, Tom Loughlin of NMFS interprets this statement to mean that, though toxic pollutants are not a cause of the decline of the Steller sea lion, they remain a cause of concern. Consequently, EPA has determined that approval of the **site-specific marine acute and chronic criteria for cyanide may be likely to adversely affect the Steller sea lion.**

" \l 4Marine Turtles

The leatherback sea turtle is found in Puget Sound. An extensive literature search found no information on the effect of cyanide on marine turtles. According to Robert Pitman (2002), the two types of turtles found in Washington face different threats. Leatherbacks face more serious problems that exposure to pollutants, while hardshells are very rare in Washington (Pitman 2002). The problems facing sea turtles are severe and include fishing by-catch, human disturbance of nests, and the taking of adults for food (Pitman 2002). These problems dwarf any environmental problems, for example aquatic pollution, that sea turtles may face (Pitman 2002). In addition, evidence suggests that cyanide does not bioaccumulate or bioconcentrate and breaks down rapidly.

According to NMFS' Peter Dutton (2002), there is little information on the effects of chemical pollutants on sea turtles, and the role that pollutants play is unknown, though it could be significant. Concern about the effects of pollutants has, however, led to growing interest in conducting research into the issue (Dutton 2002). Despite conservation, the numbers of all sea turtle species considered in this document continues to decline; though little information exists, there is concern about the effects of chemical pollutants (Dutton 2000). Due to this uncertainty, EPA has determined that the approval of the **site-specific marine acute and chronic criteria for cyanide may be likely to adversely affect the leatherback sea turtle.**

3. Summary of Determinations

See Table 8 for a summary of the determinations for the numeric criteria. " NL" indicates a not likely to adversely affect determination, "NO" indicates a no effect determination, and "L" indicates a may be likely to adversely affect determination.

Table 8. Summary of Determinations

	Cyanide	**Copper**
Fish	NL	NL
Birds	NL	NL
Marine Mammals	L	L
Marine Turtles	L	L

V. CRITICAL HABITAT

Critical habitat is defined in the ESA as "(i) the specific areas within the geographical area occupied by the species, at the time it is listed...on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by a species at the time it is listed...upon a determination...that such areas are essential for the conservation of the species" (16 U.S.C. 1532(5)(A)). The terms "conserve," "conserving," and "conservation" are defined in the ESA to mean "...to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (16 U.S.C. 1532(3)).

A. Salmonids

1. Critical Habitat Designation

Critical habitat for salmon and steelhead species includes both freshwater and estuarine environments. Currently, NMFS has not designated critical habitat in marine areas; the agency is reevaluating its determination to exclude ocean areas as critical habitat for listed salmon and steelhead ESUs, in particular examining whether marine areas require special management consideration or protection (65FR7771). This assessment will consider generally salmon and steelhead ESUs for which critical habitat has been designated.

A. Designated February 16, 2000:
- Chinook Salmon
  - Upper Columbia River Spring-run ESU
  - Lower Columbia River ESU
  - Puget Sound ESU
  - Upper Willamette River ESU
- Chum Salmon
  - Columbia River ESU
  - Hood Canal Summer-run ESU
- Sockeye Salmon
  - Ozette Lake ESU
- Steelhead
  - Upper Columbia River Basin ESU
  - Snake River Basin ESU
  - Upper Willamette River ESU
  - Lower Columbia River ESU
  - Middle Columbia River ESU

Critical habitat for salmon and steelhead designated February 16, 2000 encompasses dozens of major river basins and an array of essential habitat features (65FR7773). In general, essential habitat types for these species include: 1) substrate; 2) water quality; 3) water quantity; 4) water temperature; 5) water velocity; 6) cover/shelter; 7) food; 8) riparian vegetation; 9) space; and, 10) safe passage conditions (65FR7773). As NMFS (65FR7773) states, "Given the vast geographic range occupied by each of these salmon and steelhead ESUs and the diverse habitat types used by various life stages, it is not practical to describe specific values or conditions for each of these essential habitat features."

B. Designated December 28, 1993
   Chinook Salmon
     Snake River Fall-run ESU
     Snake River Spring/Summer-run ESU
   Sockeye Salmon
     Snake River ESU

Essential Snake River salmon habitat for both chinook and sockeye consists of four components: 1) spawning and juvenile rearing areas; 2) juvenile migration corridors; 3) adult migration corridors; and, 4) areas for growth and development to adulthood.

<u>Spawning and juvenile rearing areas</u>:
The essential features of the spawning and juvenile rearing areas of the designated critical habitat for Snake River sockeye salmon consist of adequate: 1) spawning gravel, 2) water quality, 3) water quantity, 4) water temperature, 5) food, 6) riparian vegetation, and 7) access. The essential features of the spawning and juvenile rearing areas of the designated critical habitat for Snake River spring/summer and fall chinook salmon are: 1) spawning gravel, 2) water quality, 3) water quantity, 4) water temperature, 5) instream cover/shelter, 6) food for juvenile salmon, 7) riparian vegetation, and 8) living space.

<u>Juvenile and Adult Migration corridors</u>:
Essential features of the juvenile migration corridors for Snake River sockeye salmon and Snake River spring/summer and fall chinook salmon consist of adequate: 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover/shelter, 7) food, 8) riparian vegetation, 9) space, and 10) safe passage conditions. Essential features of the adult migration corridors for Snake River sockeye salmon and Snake River spring/summer and fall chinook salmon include adequate: 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover/shelter, 7) riparian vegetation, 8) space, and 9) safe passage conditions.

<u>Growth and Development:</u>
The areas in the Pacific Ocean that threatened and endangered salmon use for growth and development are not well understood; therefore, NMFS has not designated any essential areas and features for Snake River ocean habitat.

2. Analysis of Effects

The concentration of toxic chemicals in the water column should not affect the following essential features of critical habitat: temperature, water quantity, riparian vegetation, access, instream cover/shelter, space, safe passage conditions, water velocity and substrate. Therefore, EPA's approval of Washington's numeric criteria for cyanide and copper addressed in this biological assessment is not likely to adversely affect these essential features of critical habitat.

Water quality standards for toxic chemicals characterize and define the conditions and quality of surface waters. EPA's approval of Washington's water quality standards may directly and/or indirectly affect spawning gravels, water quality, and food which are essential features of salmon habitat. The analysis in Section III indicates that the copper and cyanide criteria which were evaluated are not likely to adversely affect salmon or steelhead. Therefore, EPA's approval of Washington's numeric criteria for toxic pollutants is not likely to adversely affect water quality, spawning gravels, or food as essential features of critical habitat of salmon and steelhead.

Consequently, EPA approval of the changes to Washington's Water Quality Standards is **not likely to adversely affect salmon and steelhead designated critical habitat.**

B. Marbled Murrelet

1. Critical Habitat Designation

Critical habitat for the marbled murrelet was designated on May 24, 1996 (61FR26255). The primary elements of this critical habitat are individual trees with potential nest platforms and forest lands of at least one half site potential tree height regardless of contiguity within 0.9 km (0.5 miles) of individual trees with potential nesting platforms and that are used or potentially used by the marbled murrelet for nesting or roosting (61FR26278).

2. Analysis of Effects

Critical habitat for the marbled murrelet is terrestrial and the concentration of toxic chemicals in the water column should not affect essential features of the marbled murrelet's critical habitat. Thus, EPA approval of the changes to Washington's Water Quality Standards **will have no effect on marbled murrelet designated critical habitat.**

C. Western Snowy Plover

1. Critical Habitat Designation

On December 7, 1999, the USFWS designated 28 areas along the coast of Oregon, Washington, and California as critical habitat for the western snowy plover (64FR68507). For the western snowy plover, "primary constituent elements...are those habitat components that are essential for the primary biological needs of foraging, nesting, rearing of young, roosting, and dispersal, or the capacity to develop those habitat components" (64FR68510). These components are found in areas which support or have the potential to support intertidal beaches, associated dune systems, and river estuaries (64FR68510). Important elements of the "beach/dune/estuarine ecosystem" include surf-kast kelp, sparsely vegetated foredunes, interdunal flats, spits, washover areas, blowouts, intertidal flats (flat land between low and high tides), salt flats, flat rocky outcrops, and gravel bars (64FR68510). Some of these components can also be found in artificial environments, such as salt ponds or levees (64FR68510).

In Washington, 2 critical habitat areas have been designated. Damon Point, in Grays Harbor County, which is used by the species for nesting, and Leadbetter Point, in Pacific County, which is used by the species for nesting and wintering.

2. Analysis of Effects

Critical habitat for the western snowy plover is terrestrial and the concentration of toxic chemicals in the water column should not affect essential features of the western snowy plover's critical habitat. Thus, EPA approval of the changes to Washington's Water Quality Standards **will have no effect on western snowy plover designated critical habitat.**

D. Steller Sea Lions

1. Critical Habitat Designation

Critical habitat for the Steller sea lion consists of: Alaska rookeries, haulouts, and associated areas; California and Oregon rookeries and associated areas; and, three special aquatic foraging areas in Alaska (50CFR226.202).

2. Analysis of Effects

Critical habitat for the Steller sea lion does not include waters under the jurisdiction of the State of Washington. Thus, EPA approval of the changes to Washington's Water Quality Standards **will have no effect on Steller sea lion designated critical habitat.**

E. Green Sea Turtle

1. Critical Habitat Designation

Critical habitat for the green sea turtle was designated on September 2, 1998 (63FR46697). Green turtles are largely restricted to tropical and subtropical waters, and critical habitat consists of the waters surrounding Culebra, Mona, and Monito Islands, Puerto Rico (63FR46697). Critical habitat includes coastal waters extending seaward 3 nautical miles from the mean high water line of Culebra Island, Puerto Rico, and include Culebra's outlying keys (63FR46697).

2. Analysis of Effects

Critical habitat for the green sea turtle does not include waters under the jurisdiction of the State of Washington. EPA approval of the changes to Washington's Water Quality Standards **will have no effect on green sea turtle designated critical habitat.**

F. Leatherback Sea Turtle

1. Critical Habitat Designation

The leatherback turtle's range extends from Cape Sable, Nova Scotia, south to Puerto Rico and the U.S. Virgin Islands (NMFS 2001e). Critical habitat for the leatherback includes the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands, up to and inclusive of the waters from the hundred fathom curve shoreward to the level of mean high tide with boundaries at 17°42'12" N and 64°50'00" W (NMFS 2001e).

2. Analysis of Effects

Critical habitat for the leatherback sea turtle does not include waters under the jurisdiction of the State of Washington. EPA approval of the changes to Washington's Water Quality Standards is **will have no effect on leatherback sea turtle designated critical habitat.**

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions on endangered or threatened species or critical habitat that are reasonably certain to occur in the action area considered in this biological assessment. Future federal actions or actions on federal lands that are not related to this action are not considered in this section.

Future anticipated non-Federal actions that may occur in or near surface waters in the State of Washington include timber harvest, grazing, mining, agricultural practices, urban development, municipal and industrial wastewater discharges, road building, sand and gravel operations, introduction of nonnative fishes, off-road vehicle use, fishing, hiking, and camping. These non-Federal actions are likely to continue having adverse effects on the endangered and threatened species.

There are also non-Federal actions likely to occur in or near surface waters in the State of Washington which are likely to have beneficial effects on endangered and threatened species. These include implementation of riparian improvement measures, best management practices associated with timber harvest, grazing, agricultural activities, urban development, road building and abandonment and recreational activities, and other nonpoint source pollution controls.

Acronyms

ADFG	Alaska Department of Fish and Game
BRT	Biological Review Team (NMFS)
CRU	Cetacean Research Unit
CWA	Clean Water Act
DW	Daily Weight
Ecology	Washington Department of Ecology
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
IWC	International Whaling Commission
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTR	National Toxics Rule
ppb	Parts Per Billion
ppm	Parts Per Million
TMDL	Total Maximum Daily Load
USFWS	United States Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation
WQS	Water Quality Standard

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Appendix A
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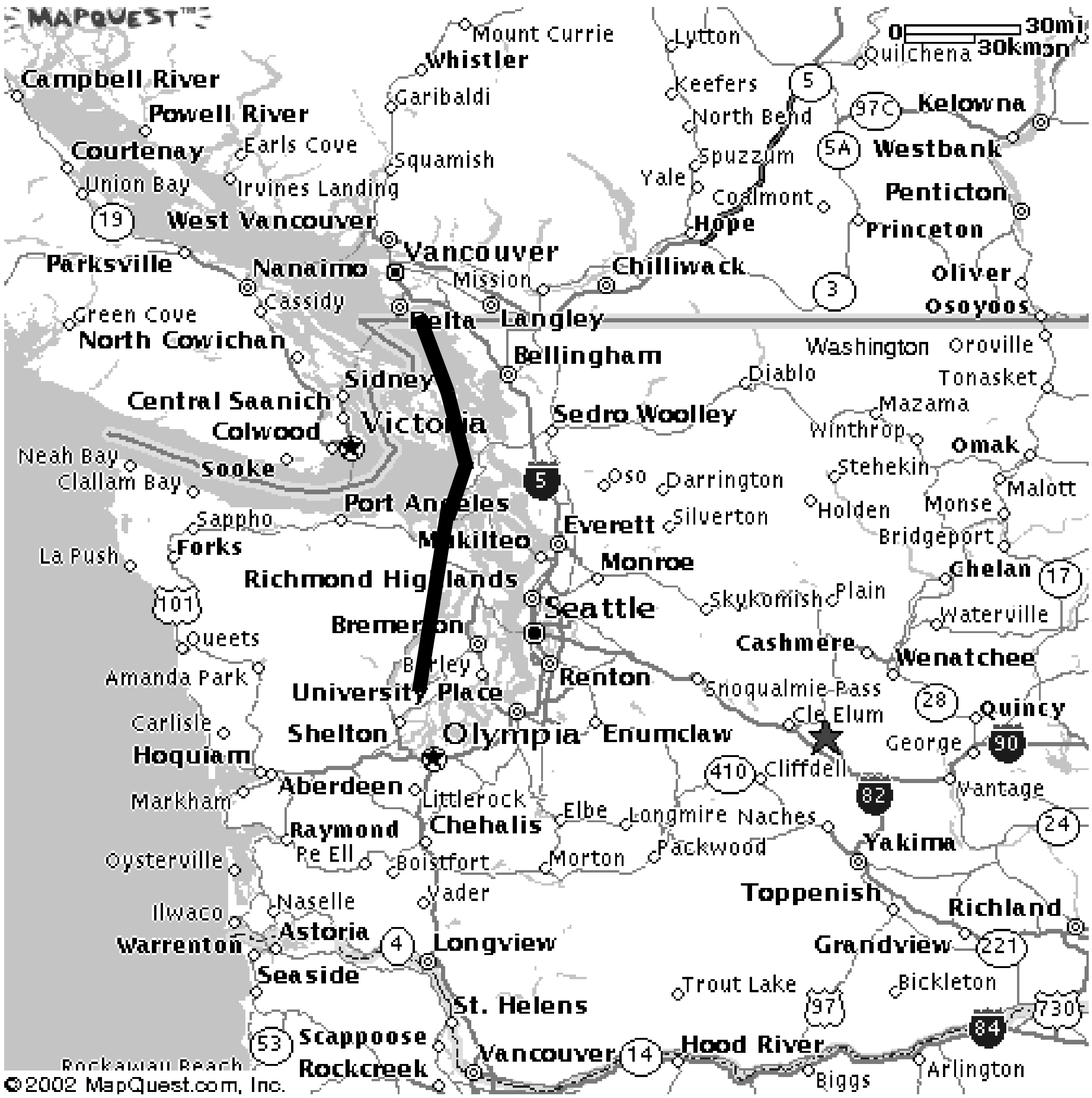

Appendix B: Regional Map

Note: The marine cyanide criteria applies to Puget Sound, or waters which are east of a line from Point Roberts to Lawrence Point, to Green Point to Deception Pass, amd south from Deception Pass and of a line from Partridge Point to Point Wilson.   The marine copper criteria applies to all marine waters in Washington.

Appendix C: Species of Concern for Endangered Species Act Consultation

<u>Marine Copper Criteria</u>

Salmonids

Chinook Salmon *(Oncorhynchus tshawytscha)*
- Snake River Fall-run ESU
- Snake River Spring/Summer-run ESU
- Columbia River Spring-run ESU
- Lower Columbia River ESU
- Puget Sound ESU
- Upper Willamette River ESU

Chum Salmon *(Oncorhynchus keta)*
- Columbia River ESU
- Hood Canal Summer-run ESU

Sockeye Salmon *(Oncorhynchus nerka)*
- Snake River ESU

Ozette Lake ESU
Steelhead *(Oncorhynchus mykiss)*
Upper Columbia River Basin ESU
Snake River Basin ESU
Upper Willamette River ESU
Lower Columbia River ESU
Middle Columbia River ESU
Coho Salmon *(Oncorhynchus kisutch)*
Puget Sound/Strait of Georgia ESU
Lower Columbia River/Southwest Washington ESU
Sea-run Cutthroat Trout *(Oncorhynchus clarki clarki)*
Southwest Washington/Columbia River ESU
Bull Trout *(Salvelinus confluentus)*
Coastal/Puget Sound ESU
Columbia River ESU
Dolly Varden *(Salvelinus malma)*

Birds
Bald Eagle *(Haliaeetus leucocephalus)*
Marbled Murrelet *(Brachyramphus marmoratus)*
Short-tailed Albatross *(Phoebastria albatrus)*
Brown Pelican *(Pelecanus occidentalis)*
Western Snowy Plover *(Charadrius alexandrinus nivosus)*

Marine Mammals
Humpback Whale *(Megaptera novaeangliae)*
Blue Whale *(Balaenoptera musculus)*
Fin Whale *(Balaenoptera physalus)*
Sei Whale *(Balaenoptera borealis)*
Sperm Whale *(Physeter macrocephalus)*
Steller Sea Lion *(Eumetopias jubatus)*

Marine Turtles
Green Sea Turtle *(Chelonia mydas)*
Leatherback Sea Turtle *(Dermochelys coriacea)*
Loggerhead Sea Turtle *(Caretta caretta)*
Olive Ridley Sea Turtle *(Lepidochelys olivacea)*0

Marine Cyanide Criteria

Salmonids
Chinook Salmon *(Oncorhynchus tshawytscha)*
Puget Sound ESU
Chum Salmon *(Oncorhynchus keta)*

Hood Canal Summer-run ESU
Coho Salmon *(Oncorhynchus kisutch)*
Puget Sound/Strait of Georgia ESU
Bull Trout *(Salvelinus confluentus)*
Coastal/Puget Sound ESU
Columbia River ESU
Dolly Varden *(Salvelinus malma)*

Birds
Bald Eagle *(Haliaeetus leucocephalus)*
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Short-tailed Albatross *(Phoebastria albatrus)*
Brown Pelican *(Pelecanus occidentalis)*
Western Snowy Plover *(Charadrius alexandrinus nivosus)*

Marine Mammals
Humpback Whale *(Megaptera novaeangliae)*
Steller Sea Lion *(Eumetopias jubatus)*

Marine Turtles
Leatherback Sea Turtle *(Dermochelys coriacea)*

Appendix D: Analysis of Effects of Toxic Pollutants to Birds

Several models were examined to determine dietary levels of toxicants in organisms exposed to parameters at the adopted water quality criteria concentrations. Often, a model requires wildlife values that are unavailable for the species of concern, or the concentration of the chemical in the sediment is needed. For fish, even if a BCF or BAF is available for a particular species, the wildlife value may not be available. Also, the more complicated models require many assumptions that can cover a wide range. For example, feeding rates, amount of diet comprised of a "contaminated" food source, potential food source trophic levels, metabolic rates, and sensitivity factors can vary by orders of magnitude. The lowest tissue concentration of a chemical in the diet that will not cause adverse effects, the NOAEL, is also expressed as "wildlife value" or "body burden". These wildlife values can cover a large range for the same organism depending on the researcher's assumptions. Given the latitude in variables such as those mentioned above and the specific requirements of the food chain/wildlife models, a general approach was chosen to estimate effects on birds. The example at the end of this section shows this approach.

For the copper criteria, BAFs/BCFs are available for fish. Since the bird species of concern in this assessment may feed on fish, then a general wildlife exposure to these species can be estimated by using the domestic poultry discussed above as a surrogate species. BCFs in aquatic life allow for the general approach presented below (that is, substituting a BCF for lack of a BAF). In estimating the dietary exposure for birds, EPA made the assumption that the bird's diet consists only of fish and that all fish eaten were contaminated.

Equation to estimate toxicant exposure to birds through diet:

> toxicant (mg/L) X BCF or BAF (mg/kg in fish/ mg/L in water) = mg/kg in diet (assuming 100% fish diet)